CHAPTER 12

COSTS OF TECHNOLOGY BASES FOR REGULATIONS

12.1 Introduction

This chapter describes the methodology used to estimate the costs to implement each of the regulatory options under consideration for the Industrial Laundries Point Source Category. Chapters 8 and 10 describe in detail the regulatory options as well as the technologies used as the bases for the options. The cost estimates, together with the pollutant reduction estimates described in Chapter 11, provide a basis for evaluating the options. The cost estimates also provide a basis for determining the economic impact of the proposed regulation on the industry at different pollutant discharge levels. The results from assessing the economic impact of the regulation are found in the Economic Assessment (EA) for the industrial laundries proposed rulemaking (1).

EPA used the following approach in estimating compliance costs for the industrial laundries industry:

- EPA mailed detailed questionnaires to a statistically selected sample of industrial laundries (discussed in Chapter 3). The information from the 193 in-scope facilities that responded was used to determine baseline wastewater treatment system design and operating status. The in-scope facilities are those that launder industrial textile items from off site as a business activity, as discussed in Chapter 6.

- EPA analyzed field sampling data to determine the pollutant concentrations of untreated wastewater in the industry (discussed in Chapter 11).

- EPA identified candidate end-of-pipe wastewater treatment technologies and grouped appropriate technologies into regulatory options (discussed in Chapters 8, 9, and 10). The regulatory options serve as the bases for compliance cost and pollutant loading calculations.

- EPA analyzed field sampling data and detailed monitoring questionnaire (DMQ) data to determine pollutant removal performance of the technology options (discussed in Chapter 11).

- EPA developed cost equations for capital and operating and maintenance (O&M) costs for each of the technologies included in the regulatory options based on information gathered from industrial laundry facilities, wastewater treatment system vendors, and engineering judgement (discussed in this chapter).

- EPA developed and used a computerized design and cost model, the Industrial Laundries Design and Cost Model (cost model), to calculate compliance costs (presented in this chapter) and pollutant loadings (presented in Chapter 11) for each option.

- EPA used output from the cost model to calculate total annualized costs in 1993 dollars for each facility for each regulatory option (presented in the EA).

EPA performed an analysis comparing each facility's annualized cost for each regulatory option to the annualized cost for the facility to have their wastewater contract hauled to an off-site treatment facility (presented in this chapter). If the cost for contract hauling was less than the cost to install and operate an on-site treatment system, the contract-hauling cost was used as the facility's cost for compliance.

EPA used the annualized costs and the pollutant loadings calculated by the cost model to calculate cost-effectiveness and the economic impact of each regulatory option on the industry (presented in the EA).

EPA estimated industry-wide costs for the five regulatory options by estimating compliance costs for the 193 in-scope facilities to purchase, install, and operate each of the technology options. Using statistically calculated facility weighting factors, EPA then extrapolated the results to the entire industrial laundries industry (1,747 industrial laundries).

The following information is discussed in this section:

- Section 12.2 discusses the costing methodology;

- Section 12.3 discusses cost modeling and summarizes cost estimating assumptions and design bases for the technologies that comprise the regulatory options;

- Section 12.4 presents the cost estimates by regulatory option; and

- Section 12.5 presents the references used in this section.

12.2 Costing Methodology

To accurately determine the impact of the proposed pretreatment standards on the industrial laundries industry, EPA estimated costs associated with regulatory compliance. The computerized cost model was developed to estimate compliance costs for each of the regulatory options. EPA used the cost model to estimate costs for the treatment technologies used as the basis for the calculated limitations of each regulatory option. Although the estimated compliance costs were developed based on implementation of these treatment technologies, EPA emphasizes that the proposed regulations do not require that a facility install or possess these technologies, but only that the appropriate facility effluent standards be met.

EPA selected a facility-by-facility model approach to develop the compliance costs as opposed to a more general modeling approach, because of the variability of processes and resultant wastewaters among industrial laundries. EPA used facility information available from responses to the detailed questionnaire to characterize the wastewater and assess existing treatment technologies at each facility. In some cases, facilities were excluded from being costed if they did not provide sufficient technical and/or economic data to be adequately characterized as to their current operations and/or economic status, respectively. For the purposes of the cost model, a facility was excluded if EPA did not have information on its flow, production, and/or wastewater treatment activities.

In other cases when more specific information was not available, EPA made engineering assumptions regarding facility operations, or used industry average data and various wastewater treatment equipment vendor and consultant information. Thus, for any given facility, the costs estimated may deviate from those that the facility would actually incur. However, because EPA based these assumptions on industry-wide data, the resulting estimates are considered accurate when evaluated on an industry-wide, aggregate basis.

As discussed in Chapter 10, EPA identified the following regulatory options:

- DAF-IL Option - Dissolved air flotation (DAF) treatment of wastewater generated from the washing of industrial laundry items only; the cost model uses long-term averages calculated from sampling data for DAF treatment of a facility's total process wastewater stream to calculate pollutant removals for the DAF-IL option.

- CP-IL Option - Chemical precipitation treatment of wastewater generated from the washing of industrial laundry items only; the cost model uses long-term averages calculated from sampling data for chemical precipitation treatment of a facility's total process wastewater stream to calculate pollutant removals for the CP-IL option.

- Combo-IL Option - Either DAF or chemical precipitation treatment of wastewater generated from the washing of industrial laundry items only; the cost model uses a single set of combined long-term averages, based on the higher long-term average calculated for each pollutant from sampling data for either DAF or chemical precipitation treatment of a facility's total process wastewater stream to calculate pollutant removals for the Combo-IL option.

- Combo-IL-2LIM Option - Either DAF or chemical precipitation treatment of wastewater generated from the washing of industrial laundry items only; the cost model uses two sets of long-term averages, based on sampling data for either DAF or chemical precipitation treatment of a facility's total process wastewater stream to calculate pollutant removals for the Combo-IL-2LIM option. For facilities currently operating DAF, the DAF limits are applied; for all other facilities, the chemical precipitation limits are applied.

- OC-Only Option - Steam-tumbling treatment of facilities' heavy industrial laundry items prior to water washing; the cost model uses target concentrations calculated from steam tumbling sampling data to calculate pollutant removals for 24 organic pollutants for the OC-Only option.

12.2.1 Cost Model Development and Structure

EPA evaluated the following three existing cost models from other EPA effluent guidelines development efforts to be used as the basis for the industrial laundries cost model:

- Metal Products and Machinery (MP&M) Phase I Industries Design and Cost Model;

- Pharmaceuticals Industry Cost Model; and

- Pesticides Formulating, Packaging, and Repackaging Industry (PFPR) Cost Model.

The MP&M and pharmaceuticals cost models were programmed in FoxPro®. These cost models have treatment technology "modules" designed to calculate the cost of each individual treatment technology. The individual modules are tied together with the cost model "driver," the main program that accesses input data, runs the modules in the appropriate order for each regulatory option, and tracks intermediate and output data. The PFPR cost model was programmed in a spreadsheet, but also designed with individual modules. Because FoxPro® provided a more flexible platform than a spreadsheet on which to build the cost model and because the data for the industrial laundries project were already stored in FoxPro® files, EPA decided to use FoxPro® for the industrial laundries cost model.

The industrial laundries cost model driver was based on the MP&M cost model driver. The major advantage of the MP&M cost model driver over the pharmaceuticals cost model driver is its ability to calculate the baseline pollutant loads and the postcompliance pollutant loads along with the costs for regulatory options. The pharmaceuticals cost model driver was not programmed to calculate pollutant loads. In addition, the MP&M cost model driver was designed to handle flow reduction technologies and practices as part of the regulatory options. This allowed pollutant concentrations and flow rates from certain streams to be adjusted as the streams were sent to flow reduction modules. Although flow reduction technologies are currently not part of the proposed regulatory options for industrial laundries, the MP&M cost model driver allows the flexibility to add them to the cost model.

EPA adapted the MP&M cost model driver for the industrial laundries cost estimation effort with one major modification: any value calculated by the cost model is stored in an output file. This allows the user of the cost model to examine the importance of each calculated value in the cost calculated for each technology module.

The inputs to the industrial laundries cost model include raw wastewater pollutant concentrations, flow rates, operating schedules, and treatment technologies currently in place for each facility costed. EPA obtained the flow rates, operating schedules, and treatment technologies currently in place from the detailed questionnaire response for each facility. As described previously, facilities that did not report flow, production, and/or treatment technology information were not included in the cost estimation effort. If facilities did not report operating days per year or hours per day, facility average data were used. EPA calculated the raw wastewater pollutant concentrations for each facility costed using sampling and DMQ data based on each facility's production data, as described in Chapter 11. The input information for the cost model was maintained in database files. Section 12.3 of this document discusses the cost model and its operation in more detail.

12.2.2 Components of the Cost of Compliance

EPA adjusted all costs calculated by the cost model to 1993 dollars because all facility-specific information in the detailed questionnaire database is from 1993. This adjustment allows direct comparison between financial data reported in the detailed questionnaire and calculated compliance costs for each facility. Costs were adjusted using the Chemical Engineering (CE) Plant Cost 1993 annual index value of 359.2 (2) and the index value for the year in which the costs were originally reported in the following formula:

$$AC = OC\left(\frac{359.2}{OCI}\right)$$

where:

AC	=	Adjusted cost, 1993 dollars
OC	=	Original cost, dollars
OCI	=	Original cost year index.

EPA used the cost model to calculate annual operating and maintenance (O&M) and capital costs for each technology and to sum the capital and O&M costs for all technologies at each facility. Annual O&M costs comprise all costs related to operating and maintaining the treatment system for a period of one year, including the estimated costs for compliance monitoring of the effluent. O&M costs include the following:

- Chemical usage;

- O&M labor and materials;

- Removal, transportation, and disposal of any waste solids, sludges, oils, or other waste products generated by the treatment system; and

- Utilities, such as electricity, required to run the treatment system.

Sources of O&M costs primarily included literature references and vendor information. Information from other EPA effluent guidelines development efforts and engineering judgement were used in some instances when estimating O&M labor. EPA obtained the wage rate for all required labor to properly install, operate, and maintain the systems associated with the technology bases from The Richardson Rapid System Process Plant Construction Estimating Standards (3) as the average hourly rate for one installation worker. The average rate in 1994 was $25.90 per hour. This rate was scaled back to a 1993 rate of $25.27 per hour using the CE Plant Cost indices. It was assumed that an industrial laundry treatment system operator would receive an equivalent rate of pay as an installation worker. Assumptions on the number of hours required of a worker to operate a treatment system were made for each piece of equipment that was included in the treatment system for each regulatory option. Section 12.3 of this document discusses these assumptions in detail.

EPA obtained the cost for electricity used by various treatment technologies from the Department of Energy's Monthly Energy Review (4). The average cost of electricity for industrial facilities for the year 1993 was $0.049 per kilowatt-hour.

Table 12-1 presents the O&M unit costs used by the cost model and includes references for the origin of each cost.

Capital costs comprise direct and indirect costs associated with the purchase and installation of wastewater treatment equipment. Primary sources of the capital costs were vendor information and literature references. Table 12-2 presents the unit capital costs used by the cost model and includes references for the origin of each cost. Typically, direct capital costs include the following:

- Purchase of treatment equipment and any accessories;

- Purchase of treatment equipment instrumentation (e.g., controllers);

- Installation costs (e.g., labor and rental fees for equipment such as cranes);

Table 12-1

Operation and Maintenance Unit Costs Used by the Cost Model

Activities			
Activity	**Cost (1993 $s)**	**Module(s)**	**Reference**
Compliance monitoring lab fee	20,200 per year	Compliance Monitoring	(19)
Contract hauling of bulk wastewater	537 per full load (5,000 gallons bulk liquid)	Contract Haul	(18)
Monitoring fee for contract hauled wastewater	200 per year	Contract Haul	(18)
Nonhazardous dewatered sludge disposal	2.12 per cubic foot	Sludge Dewatering	(13)
Treatment fee for contract hauled wastewater	0.35 per gallon	Contract Haul	(18)
Chemicals			
Chemical	**Cost (1993 $s)**	**Module(s)**	**Reference**
Anionic polymer	2.48 per pound	DAF, Chemical Precipitation	(10, 12)
Cationic polymer	1.34 per pound	DAF, Chemical Precipitation	(10, 12)
Ferric chloride	0.49 per pound	DAF	(10)
Hydrated lime	67.50 per ton	Chemical Precipitation	(12)
Perlite	0.63 per pound	DAF	(10)
Quick lime	45 per ton	Chemical Precipitation	(12)
Sodium hydroxide (50%)	0.138 per pound	pH Adjustment	(15)
Sulfuric acid (93%)	75 per ton	DAF, pH Adjustment	(10, 15)
Equipment			
Equipment	**Cost (1993 $s)**	**Module(s)**	**Reference**
Agitator maintenance and materials cost	5% of the direct capital cost of agitator per year	Equalization, pH Adjustment	(8, 15)
Air-operated sludge pump maintenance and materials cost	1% of the direct capital cost of pump per year	Pump	(6)
Building maintenance and materials cost	3.5% of the direct capital cost of the building per year	Building	(16, 17)
Chemical feed system materials maintenance and cost (0.01 to 3,200 lb/hr)	Cost per year = 2,868.6 + 4.0721 × C + $(1.7502 \times 10^{-5}) \times C^2$ (C = Capacity in pounds per hour)	DAF, pH Adjustment	(10, 15)

Table 12-1 (Continued)

Equipment (Continued)			
Equipment	**Cost (1993 $s)**	**Module(s)**	**Reference**
Compliance monitoring materials cost	248.83 per year	Compliance Monitoring	(19)
Continuous/batch chemical precipitation treatment unit maintenance and materials cost	5% of the direct capital cost of the chemical precipitation unit per year	Chemical Precipitation	(12)
Continuous DAF treatment unit maintenance and materials cost	2% of the direct capital cost of the DAF unit per year	DAF	(9, 10)
Positive displacement or centrifugal pump maintenance and materials cost	1% of the direct capital cost of pump per year	Pump	(6)
Reaction tank maintenance and materials cost	5% of direct capital cost of tank per year	Equalization, pH Adjustment, Contract Haul	(8, 15, 19)
Replacement pH probe	276.79 per probe	pH Adjustment	(15)
Replacement plates for 48-inch and 60-inch shaker screen units	435.49 to 633.52335.14 per plate replaced every two years	Screen	(7)
Replacement porous collection bags for shaker screen lint	200 per year	Screen	(7)
Replacement screens for 48-inch and 60-inch shaker screen units	180.78 to 263.76 per screen replaced twice per year	Screen	(7)
Replacement sliders for 48-inch and 60-inch shaker screen units	106.94 to 154.09 per screen	Screen	(7)
Storage tank maintenance and materials cost	2% of direct capital cost of tank per year	Screen	(7)
General Costs			
Item	**(Cost (1993 $s)**	**Module(s)**	**Reference**
Electricity usage fee	0.049 per kilowatt-hour	All	(4)
O&M labor rate	25.27 per hour	All	(3)

Table 12-2

Capital Unit Costs Used by the Cost Model

Capital Costs (includes crane rental)			
Item	**Cost (1993 $s)**	**Module(s)**	**Reference**
Air-operated sludge pump (4 to 60 gpm)	Cost = 571.91 + 37.161 × C - 0.18842 × C^2 per pump (C = Capacity in gpm)	Pump	(6)
Batch chemical precipitation treatment units (100 to 2,500 gallons)	Cost = 23,773 + 19.963 × V - $2.8223*10^{-3}$ × V^2 per unit (V = batch size in gallons)	Chemical Precipitation	(12)
Building	19.38 per square foot	Building	(17)
C-Clamp-mounted agitators (0.25 to 2 hp)	Cost = 3,168.998 + 2965.115 x log(P) per agitator (P = power requirement in hp)	pH Adjustment	(15)
Centrifugal wastewater transfer pumps (> 27 gpm)	Cost = 2,758.989 × long (C) - 2,185.941 per pump (C = capacity in gpm)	Pump	(6)
Chemical feed system (0.01 to 3,200 lb/hr)	Cost = 12,421 + 38.142 × C - (3.8125 × 10^{-3}) × C^2 per unit (C = Capacity in lbs/gal)	DAF, pH Adjustment	(10, 15)
Concrete slab	8.39 per square foot	Building	(17)
Concrete curb	6.51 per foot	Building	(17)
Continuous chemical precipitation treatment units (2 to 150 gpm)	Cost = 47,192 + 1,129.6 × C - 1.3255 x C^2 per unit (C = capacity in gpm)	Chemical Precipitation	(12)
Continuous DAF treatment units (25 to 1,000 gpm)[1]	Cost = 111,370 × log (C) - 139,260 per unit (C = capacity in gpm)	DAF	(10)
Covered and flanged fiberglass tanks (110 to 50,000 gallons)	Cost = 2,839.2 + 0.9004 × V per tank (V = volume in gallons)	Contract Haul	(19)
Covered and flanged fiberglass tanks (110 to 50,000 gallons)	Cost = 2,927.1 + 0.9182 × V per tank (V = volume in gallons)	Equalization	(8)
Equipment and labor required for washer modification for split stream capability	4,096.61 to 7,599.38 per washer	Stream Splitting	(5)

Table 12-2 (Continued)

Capital Costs (includes crane rental)			
Item	**Cost (1993 $s)**	**Module(s)**	**Reference**
Filter press (5 to 125 ft^3)	Cost = 33,331 x ln(C) - 36,195 per press (C = capacity in ft^3)	Sludge Dewatering	(13)
Flange-mounted agitators (0.25 to 5 hp)	Cost = 4,247.414 + 2,616.527 × log (P) per agitator (P = power requirement in hp)	Equalization	(8)
Open polyethylene tank (55 to 6,400 gallons)	Cost = 362.48 + 1.5907 × V - (1.0583 × 10^{-4}) × V^2 per tank (V = Volume in gallons)	Screen, pH Adjustment	(7, 15)
pH controller	1,554.77 per controller	pH Adjustment	(15)
Positive displacement wastewater transfer pumps (<3 to 27 gpm)	839.38 to 2130.04 per pump	Pump	(6)
PVC piping for stream segregation retrofit[2]	27.08 per foot	Stream Splitting	(5)
Shaker screen unit (48-inch and 60-inch units)	8,131.76 to 9,542.93 per unit	Screen	(7)
Utility installation and hook up	1.14 per square foot	Building	(17)

[1]The same DAF unit (750 gpm) will be costed for capacities ranging within 750 to 1,000 gpm, as this size unit is capable of treating up to 1,000 gpm of wastewater flow.
[2]An additional $500 per facility was allowed to account for any necessary elbow joints or other connections.

- Construction of buildings or other structures to house major treatment units (e.g., foundation slab, enclosure, containment, lighting, and electricity hook-ups); and

- Purchase of necessary pumps (e.g., for wastewater transfer, chemical addition, sludge handling).

Indirect capital costs typically include the following:

- Purchase and installation of necessary piping to interconnect treatment system units (e.g., pipe, pipe hangers, fittings, valves, insulation, similar equipment);

- Purchase and installation of electrical equipment (e.g., switches, wire, fittings, grounding, instrument and control wiring, lighting panels);

- Engineering costs (e.g., administrative, legal, process design and general engineering, communications, consultant fees, travel, supervision, and inspection of treatment equipment);

- Site maintenance (e.g., roads, walkways, fences, parking areas, landscaping, site clearing);

- Contingency (e.g., compensation for unpredictable events such as foul weather, price changes, small design changes, and errors in estimates); and

- Contractors' fees.

For each technology, EPA accounted for each required indirect capital cost by using a factor related to purchased and installed capital costs. The total capital investment is obtained by multiplying the direct capital cost by the indirect capital cost factor. Table 12-3 presents the components of the total capital investment, including the indirect capital cost factor used by the cost model.

12.2.3 Treatment-in-Place Credit Methodology

EPA evaluated facility responses to the detailed questionnaire to determine which treatment technologies are currently in place and in operation at each facility. Facilities were given credit for having operational treatment in place; these treatment credits were used to develop cost estimates for system upgrades instead of new systems where appropriate. No compliance costs beyond necessary additional monitoring were estimated for facilities that were determined to have treatment equivalent to an option currently in use. EPA's methodology for giving credit to facilities for existing treatment on site is discussed below.

Table 12-3

Components of Total Capital Investment

Number	Component	Cost
1	Equipment capital costs, including required accessories, installation, delivery, instrumentation, building, containment, pumping	Direct capital cost
2	Piping	10% of the direct capital cost
3	Electrical	2% of the direct capital cost
4	Engineering/administrative/legal services	10% of the direct capital cost
5	Total Plant Cost	1.22 × direct capital cost (Sum of Components 1 through 4)
6	Site Work	1.5% of the total plant cost
7	Contingency	13% of the total plant cost
8	Contractor's Fee	5% of the total plant cost
9	**Total Capital Investment**	1.46 × direct capital cost (Sum of Components 5 through 8)

Source: Industrial Laundries Design and Cost Model

- Stream splitting - EPA gave stream-splitting credit to facilities that indicated that a portion of their wastewater was currently being segregated for treatment, regardless of the specific method used to segregate the stream.

- Mechanical fine screen (i.e., a shaker or rotary screen) - EPA gave full screen credit to facilities that had screens in place that treated at least a portion of the facility's stream under the assumption that the screen was adequate to treat a larger amount of wastewater stream for the purposes of the IL options.

- Adequate equalization capacity - EPA gave facilities the following credits: full credit for mixed tanks having a minimum residence time (two hours); partial credit for unmixed tanks having at least the minimum residence time (costs for agitators were added); no credit to facilities having tanks with less than the minimum residence time; and full credit for an agitator if facilities indicated that they had one on site.

- Key treatment units (i.e., DAF, or chemical precipitation) - EPA gave facilities full option credit if they indicated that they had the respective key treatment unit in place. EPA used certain assumptions and specific criteria to determine the presence of the key treatment units; Section 12.3 of this document discusses these assumptions and criteria further.

- DAF treatment unit (applicable to the CP-IL option) - EPA estimated a salvage value for DAF units currently in place at industrial laundries, based on the reported age of the equipment and estimated capital cost. EPA also estimated the annual DAF O&M cost for each facility. The salvage value and annual cost for the DAF unit were then credited toward the capital and annual costs, respectively, that were calculated for the chemical precipitation unit as part of the costs for compliance under the CP-IL regulatory option. A lower indirect capital cost factor was also applied toward the installation of the chemical precipitation unit at these facilities. EPA assumed that facilities that are replacing an existing piece of equipment would not incur some of the site preparation and auxiliary equipment (e.g., piping and electrical hookups) costs that are included in the indirect cost factor, as described in Section 12.2.2 of this document. Section 12.3 further discusses this treatment-in-place cost estimate.

- Sludge dewatering devices - EPA gave facilities full sludge dewatering credit if they indicated that their sludge dewatering device treated sludge being generated by either DAF or chemical precipitation; facilities that indicated that they treat their sludge with a conditioner received full sludge conditioning credit in the DAF-IL regulatory option.

- pH adjustment (applicable to options utilizing chemical precipitation only) - EPA gave facilities the following credits: full credit for pH adjustment with no minimum residence time required if they indicated that they have a mixed tank with chemical addition; partial credit for a tank, an agitator, an acid/base feed system, or some combination of these three components (these facilities were costed only for the missing component(s)); and full credit in the total stream treatment options only if they indicated that they use in-line pH adjustment.

- Space inside of the facility - EPA costed facilities for a building of adequate size to house the treatment option equipment only if they indicated that they did not currently have space inside; no partial credit was given.

- Monitoring costs - EPA gave facilities either full or partial credit based on whether the facilities currently monitor their wastewater effluent.

12.3 Cost Modeling

12.3.1 Cost Model Driver

As described earlier, EPA developed a computerized design and cost model to estimate compliance costs and pollutant loadings for the industrial laundries regulatory options, taking into account each facility's treatment in place. The cost model was programmed with modules that allowed the user to specify various combinations of technologies and practices to be costed as required by each regulatory option. In the context of the industrial laundries cost estimation effort, "cost model" refers to the overall computer program and "module" refers to a computer subroutine that generates costs and pollutant loadings for a specific technology or practice (e.g., chemical precipitation, contract hauling). Some modules were adapted from cost models used for previous EPA rulemaking efforts, such as MP&M, while others were developed specifically for this rulemaking.

EPA developed cost modules for the wastewater treatment technologies and practices, as well as auxiliary components of these technologies (e.g., pumps, buildings) included in the industrial laundries regulatory options. Chapter 10 discusses in greater detail the specific combinations of these technologies into the regulatory options. These technologies, components, and practices are listed below:

- Organics control via steam tumbling of heavy industrial laundry items;
- Wastewater and sludge transfer pumps;
- Buildings;

- Stream splitting;
- Mechanical screening;
- Equalization;
- Dissolved air flotation;
- Chemical precipitation;
- Sludge dewatering;
- pH adjustment; and
- Contract hauling of untreated wastewater.

As discussed in Section 12.2.1, EPA developed a cost model driver to organize the treatment technology modules and track the costs for the entire industry. The cost model driver performs the following functions, as applicable, for each technology designed for a facility:

- Locates and opens all necessary input data files;

- Stores input data entered by the user of the cost model;

- Opens and runs each of the technology modules in the appropriate order for each option;

- Calculates and tracks the following types of information generated by each technology module:

  — Total direct capital costs;
  — Total direct annual costs;
  — Electricity used and associated cost;
  — Sludge generation and associated disposal costs;
  — Effluent flow rate;
  — Effluent pollutant concentrations; and

- Sends tracked costs by regulatory option to a storage file that may be printed or maintained in electronic form for further manipulation.

The following sections list the major technologies included as modules within the cost model and describe the major assumptions and costing methodology used for each.

12.3.2 Stream Splitting

EPA estimated costs for a facility to install and operate a means of segregating wastewater streams generated from washing specific items. Stream splitting was costed for the IL options in order for each facility to direct all wastewater generated from the washing of industrial items to the wastewater treatment system, while allowing the facility to discharge wastewater generated from the washing of nonindustrial items (i.e., linen items) to the sewer without treatment. The costs generally comprised the retrofitting of existing washers to include dual valves for discharging wastewater to separate conduits and the costs associated with operating and maintaining these valves. The costs also included a means to divide the facility's existing trench and sump system and direct the wastewater flows to separate locations.

Capital and annual costs for the following equipment were included in the stream-splitting module:

- Retrofitting of existing washers with dual valves and associated control equipment; and

- Piping and pumping of wastewater to be treated to the treatment system.

Direct capital costs were dependent upon the required size for the dual-valve fitting, which was determined based on the facility-reported size of washer(s) and assumptions regarding the number of washers to be retrofitted. EPA assumed that no additional annual costs would be associated with the operation of dual-valves on existing machines. It was assumed that all facilities had in place a trench and sump system, since that is the method used in industrial laundries to transport process wastewater to the sewer. If a facility did not report that it currently segregates its wastewater, costs were calculated for the required sized valve(s), 200 feet of PVC piping, and other connections necessary to direct the wastewater to be treated to the first unit of the treatment system (i.e., the equalization tank). If a facility indicated that it currently segregates its wastewater, the cost model calculated a zero capital and annual cost for stream splitting for that facility.

It was estimated by the equipment vendor that it would take one worker three to four days to install the valves, pipes, and pumps for the stream-splitting process. It was also estimated that another 30 minutes would be required for each washer formula to be programmed (5). Based on site visits, EPA assumed that a typical washer controller contains 15 formulae, amounting to 7.5 hours of programming time per washer. These estimates are included as part of the installation labor cost for stream splitting.

The cost for an air-operated sludge pump to transfer the industrial laundry item wastewater to the equalization tank, including the necessary installation and operating labor, was also included as part of the stream-splitting module. If a facility indicated that it was currently transferring each segregated stream to a treatment unit , it was given credit for having the pump in place. Refer to Section 12.3.3 below for a more detailed description of the pumps cost module.

12.3.3 Pumps

EPA estimated costs for a facility to install and operate pumps, as necessary, to transfer wastewater and sludge from one treatment unit to another within the technology options. A cost for an air-operated positive displacement pump was calculated in situations where the wastewater was presumed to contain a high amount of solids (e.g., wastewater discharged directly from washers and sludge streams). Where wastewater was to be transferred from one treatment unit to another, a cost for a positive displacement pump was calculated for flows up to 27 gpm and a centrifugal pump was costed flows greater than 27 gpm.

Direct capital and annual costs were calculated based on the required size of each type of transfer pump. Both types of pumps were sized based on the required flow rate calculated by the cost model using mass balances around each treatment unit. EPA developed the convention that costs calculated for each treatment unit module would include the capital and annual costs for an effluent pump. Exceptions to this convention occur in the cost for the shaker screen in the IL options that included both an influent and effluent pump. Also, a cost was not calculated for an effluent pump in situations where the treatment unit is the last in the option's treatment train (e.g., the DAF module), because it was assumed that the wastewater can flow by gravity into the sewer.

Direct annual costs included O&M labor and material costs and energy costs. No energy costs were associated with the air-operated positive displacement pumps because EPA assumed that all industrial laundries currently have an air compressor and supply line available to operate the positive displacement pump without incurring any additional costs.

The pump module includes an estimate of installation and O&M labor costs, based on the size and type of pump being costed. All labor estimates are based on information obtained from past effluent guidelines costing efforts, as well as engineering judgement. Installation is estimated to take one worker from 1.5 to 42 hours for various types of positive displacement and centrifugal pumps, up to a 750-gpm capacity. Typically, the annual operating labor required for each pump is approximately 15 minutes per week and maintenance activities require approximately 15 to 30 minutes per week (6).

EPA assumed that facilities that reported having two sequential treatment units in place also have the necessary transfer pump in between, and therefore calculated zero capital and annual costs for the transfer pump. All other facilities that did not report having a treatment unit located downstream from the unit costed in the module received capital and annual costs for an effluent transfer pump. For example, a facility that reported having an equalization tank followed by an oil-water separation tank in place received no costs for an effluent pump in the equalization module. However, a facility that reported an equalization tank followed by discharge to the sewer received both capital and annual costs for an equalization tank effluent pump, sized sufficiently to transfer wastewater to the next required treatment unit in the option.

12.3.4 Screening

Mechanical screens are commonly used at industrial laundries to remove lint and other solid constituents from wastewater. Therefore, in each of the IL regulatory options, EPA estimated costs for mechanical screening of a facility's untreated wastewater from the washing of nonindustrial laundry items prior to recombination with treated wastewater from the washing of industrial items. The module calculates the costs necessary to pump the wastewater to be screened from the sump to the screen; mechanically remove lint suspended in the wastewater; discharge the lint into a collection vessel (e.g., a drum or bag); discharge the screened wastewater into a collection tank; and pump the screened wastewater from the collection tank to the next unit in the option's treatment train.

Capital and annual costs for the following equipment were included in the screening module:

- An influent positive displacement pump;
- A shaker screen;
- A screen effluent holding tank; and
- A centrifugal effluent pump.

Direct annual costs included O&M labor and material costs, energy costs, and lint disposal costs. The disposal costs were based on the average nonhazardous disposal costs reported by facilities for disposing of collected lint from screens. Both the direct capital and annual costs for screens were based on the required size of the screen, which was determined based on the input flow rate(s) used by the cost model. Based on sampling data, EPA assumed that the flow rate and pollutant loads are unaffected by the screening operation. Therefore, the screen module calculated the flow rate and pollutant loads in the effluent from the screen to be equal to those in the influent.

The screen module includes an estimate of installation and O&M labor costs for the screen unit and effluent holding tank. All labor estimates are based on information obtained from equipment vendors, as well as engineering judgement. Installation of the shaker screen unit and holding tank is estimated to take one worker four hours and seven hours, respectively. The annual operating labor required for changing out each drum or sack of collected lint is calculated assuming it takes one worker 10 minutes per sack. The number of drums or sacks that will be changed per year is calculated based on average lint generation rates (gallons of lint removed per gallon of wastewater screened) that were reported by industrial laundry facilities in the detailed questionnaire. Annual maintenance labor for the shaker screen was estimated by the vendor to be 75 minutes per year to regularly replace various parts (e.g., the screen, sliders, and perforated plates) and approximately 30 minutes per week to grease the motor bearings. The annual O&M labor cost for the holding tank is not calculated as a separate item, but is included as part of the estimating factor for the total annual cost (i.e., two percent of the direct capital cost of the tank), based on estimates used in past effluent guidelines efforts (7).

A cost was calculated for a screen if a facility did not report that it currently has a mechanical screen in place. Facilities reporting any type of mechanical screening (e.g., shaker screen, rotary screen) in place received zero capital and annual costs for the screen. EPA assumed that a facility reporting that it currently screens any portion of its wastewater would also be able to screen the wastewater generated from washing its industrial laundry items and, therefore, EPA calculated zero capital and annual costs for the screen in the IL options.

Costs for a maximum of two wastewater pumps to transfer the wastewater to the screen and from the holding tank to the next treatment unit, including the necessary installation and operating labor, were also included as part of the shaker screen module. If a facility indicated that it was currently screening at least a portion of its wastewater, it was given credit for having the influent pump. If it also indicated that it was transferring the screened water to another treatment unit, it was also given credit for the effluent pump. Refer to Section 12.3.3 of this document for a more detailed description of the pumps cost module.

12.3.5 Equalization

EPA estimated costs for the equalization of a facility's industrial laundry wastewater in the IL options. The equalization module calculates the costs necessary to equalize the wastewater prior to treatment in a mixed tank sized to absorb fluctuations in flow, pollutant load, and pH and to pump the equalized wastewater to the next unit in the option’s treatment train.

Capital and annual costs for the following equipment were included in the equalization module:

- A closed tank;
- A mixer(s); and
- A centrifugal effluent pump.

Direct annual costs included O&M labor and material costs, as well as energy costs. Both the direct capital and annual costs for the equalization tanks were based on the required size of the tank. The tanks were designed to have a four-hour residence time, based on the median reported residence time for equalization tanks in the detailed questionnaire. The required size of the tanks was therefore calculated from this design parameter and the influent flow rate for each facility. The required mixer size, as well as the number of mixers, was calculated based on the size of the tank using the design parameter of 0.5 mixer hp per 1,000 gallons of tank capacity (8). EPA assumed that the pollutant loads are unaffected by equalization and, therefore, the module calculated the pollutant loads in the effluent from the equalization tank to be equivalent to those in the influent.

The equalization module includes an estimate of installation and O&M labor costs for the equalization tank and mixer. All labor estimates are based on information obtained from equipment vendors, as well as past effluent guidelines costing efforts and engineering judgement.

Installation for the equalization tank and mixer is estimated to take five workers eight hours and one worker 2.4 hours, respectively. The annual O&M labor cost for the equalization tank and mixer is not calculated as a separate item, but is included as part of the estimating factor for the annual cost (i.e., five percent of the direct capital cost of the items), based on estimates used in past effluent guidelines efforts (8).

A cost was calculated for an equalization tank if a facility did not report that it has a large enough tank currently in place. Facilities that had tanks with a minimum residence time of two hours were given full credit for the equalization tank, and the module calculated zero capital and annual costs for the tank. Likewise, facilities that reported having a mixer on site were given full credit for the mixer.

The costs for the effluent wastewater pump to transfer the wastewater to the next treatment unit, including the necessary installation and operating labor, were also included as part of the equalization module. If a facility indicated that it was currently transferring the stream to another treatment unit, it was given credit for having the effluent pump in place. Refer to Section 12.3.3 of this document for a more detailed description of the pumps cost module.

12.3.6 Dissolved Air Flotation

EPA estimated costs for DAF treatment of wastewater generated from the washing of industrial laundry items in the DAF-IL, Combo-IL, and Combo-IL-2LIM options. The DAF module calculates the costs necessary to treat the wastewater with sulfuric acid, ferric chloride, and cationic and anionic polymers to form an agglomerated floc containing pollutants; float the floc to the surface of the unit; remove the floating floc from the wastewater; pump the collected floc to a sludge conditioning tank and treat it with perlite; pump the conditioned sludge to sludge dewatering; and discharge the DAF-treated wastewater to the sewer.

Capital and annual costs for the following equipment were included in the DAF module:

- An acid-feed system;
- A DAF unit, including three chemical addition units, pH controller, chemical premix tanks, and positive displacement sludge transfer pump; and
- An open sludge conditioning tank with a mixer.

Direct annual costs included O&M labor and material costs, energy costs, and raw material (e.g., sulfuric acid, ferric chloride, cationic polymer, anionic polymer, and perlite) costs. Both the direct capital and annual costs for the DAF unit were based on the required capacity of the unit to treat a continuous flow of wastewater. The required capacity of the unit was calculated based on the influent flow rate(s) in gallons per minute of flow. The chemical addition rates were determined based on average reported amounts of chemical per gallon of wastewater treated. The following chemical addition rates were used by the DAF cost module:

Chemical	Gallons of Chemical per 10,000 Gallons of Industrial Laundry Wastewater Flow
Sulfuric acid	0.8
Ferric chloride	0.9
Cationic polymer	2
Anionic polymer	0.07
Perlite	0.25 pounds per pound of sludge collected from the DAF unit on a dry-solids basis

The recommended amount of perlite added per pound of DAF sludge was provided by a chemical vendor. The DAF module calculated pollutant loads in the treated wastewater effluent using long-term averages calculated from DAF system sampling and DMQ data. The module also calculated effluent and sludge flow rates based on a mass balance around the unit using the influent flow rates of wastewater and chemicals, as well as the amount of solids removed from the wastewater though DAF treatment.

The DAF module includes an estimate of installation and O&M labor costs for the DAF unit. All labor estimates are based on information obtained from equipment vendors, as well as past effluent guidelines costing efforts and engineering judgement. Installation labor for the DAF system is estimated by a vendor to be included in an installation cost factor of six percent of the purchased cost. The vendor estimated that the annual operating labor required one worker four hours per day, mostly to condition the sludge prior to dewatering. The maintenance labor for the DAF unit was estimated to be included as part of the total maintenance cost factor of two percent of the DAF system capital cost (9).

The DAF module also includes installation and O&M labor costs for the chemical feed system. The installation and annual maintenance labor for the chemical feed system were calculated with the total capital and annual costs, respectively, from the cost curves obtained from past effluent guidelines costing efforts. The labor hours were not broken out as separate items (10).

A cost was calculated for a DAF unit if a facility did not report that it currently treats its wastewater with DAF. Facilities that had DAF units of sufficient capacity were given full option credit. For example, a facility that reported treating its total wastewater flow with DAF was given full credit for all of the IL options and received only monitoring costs to comply with the proposed rule under these options. However, a facility that reported treating a portion of its wastewater was evaluated as to whether it had sufficient DAF capacity to treat the wastewater according to each option. For example, a facility reported that it treats 35 percent of its wastewater with DAF; 50 percent of its wastewater is industrial laundry wastewater. Under the DAF-IL option, it needs to treat 15 percent more of its wastewater to comply with the option requirements. The facility received capital and annual costs for a DAF unit sized to treat 15 percent of its wastewater flow. This additional unit together with the unit currently in place can treat the 50 percent industrial laundry wastewater flow.

Based on final long-term average concentrations for chemical precipitation and DAF gathered from sampling and DMQ data, chemical precipitation achieves lower pollutant concentrations in the treated wastewater than DAF. Likewise, ultrafiltration and microfiltration are considered to provide greater pollutant removals than DAF (11). Therefore, facilities with chemical precipitation, ultrafilters, or microfilters received treatment-in-place credit for having a complete DAF system for treatment of all or a portion of their process wastewater, as appropriate.

12.3.7 Chemical Precipitation

EPA estimated costs for chemical precipitation treatment of wastewater generated from washing industrial laundry items in the CP-IL, Combo-IL, and Combo-IL-2LIM options. The chemical precipitation module calculates the costs necessary to treat the wastewater with lime and cationic and anionic polymers to precipitate and agglomerate pollutants from the wastewater; settle the precipitate to the bottom of the treatment tank in batch systems or continuously remove the precipitate with inclined plates in continuous systems; and pump the chemical precipitation-treated wastewater from the chemical precipitation unit to the next unit in the option’s treatment train.

Capital and annual costs for the following equipment were included in the batch chemical precipitation system module:

- A mixed batch treatment tank;
- Three chemical addition units with pH controller;
- A positive displacement sludge transfer pump;
- A sludge holding tank; and
- A centrifugal effluent pump.

Capital and annual costs for the following equipment were included in the continuous chemical precipitation system module:

- A continuous chemical precipitation unit (including three chemical addition units, pH controller, chemical premix tanks and inclined plate settlers);

- A positive displacement sludge transfer pump;
- A sludge holding tank; and
- A centrifugal effluent pump.

Direct annual costs included O&M labor and material costs, energy costs, and raw material (e.g., lime, cationic polymer, and anionic polymer) costs. Both the direct capital and annual costs were based on the required capacity of the unit to treat either a batch of wastewater or a continuous flow of wastewater, which was calculated based on the influent flow rate(s). Costs were calculated for batch units for facilities with less than 2,500 gallons per day of flow and continuous units for facilities with flows greater than 2,500 gallons per day. The chemical addition rates used by the module were determined based on average amounts of chemical per gallon of wastewater treated that were reported in responses to the detailed questionnaire and by sampled facilities. The following chemical addition rates were used by the chemical precipitation cost module:

Chemical	Amount of Chemical Added per 10,000 Gallons of Industrial Laundry Wastewater Flow
Lime	100 pounds
Cationic Polymer	2 gallons
Anionic Polymer	0.07 gallon

The module calculates pollutant loads in the treated wastewater effluent using long-term averages calculated from chemical precipitation system sampling and DMQ data. The module also calculates effluent and sludge flow rates based on a mass balance around the unit using the influent flow rates of wastewater and chemicals, as well as the amount of solids removed from the wastewater though chemical precipitation treatment.

The chemical precipitation module includes an estimate of installation and O&M labor costs for the batch and continuous units. All labor estimates are based on information obtained from an equipment vendor, as well as past effluent guidelines costing efforts and engineering judgement. Installation for the chemical precipitation systems is estimated by the vendor to take one worker 40 hours for the smallest system and two workers 80 hours for the largest system. The O&M labor for the chemical precipitation unit was estimated to be included as part of the estimating factor for the total annual cost (i.e., five percent of the chemical precipitation system capital cost), based on past effluent guidelines costing efforts (12).

A cost was calculated for a chemical precipitation unit if a facility did not report that it currently treats its wastewater with chemical precipitation. Facilities that had chemical precipitation units of sufficient capacity were given full option credit. For example, a facility that reported treating its total wastewater flow with chemical precipitation was given full credit for all of the IL options and received only monitoring costs to comply with the proposed rule under these options. However, a facility that reported treating a portion of its wastewater with continuous chemical precipitation was evaluated as to whether it had sufficient chemical precipitation capacity to treat the wastewater according to each option, similar to the example presented in Section 12.3.6 for the DAF technology. Most facilities that have a batch chemical precipitation unit in place have a significant amount of untreated wastewater that would require treatment under the IL options, such that a continuous chemical precipitation unit would be required in addition to the batch unit in place. EPA assumed that these facilities would not continue to operate both a batch and continuous unit simultaneously. Instead, these facilities received no credit toward the IL options and received capital and annual costs to install and operate a new continuous system appropriately sized to treat the facility's industrial laundry wastewater.

The costs for the effluent wastewater pump to transfer the wastewater to the next treatment unit, including the necessary installation and operating labor, were also included as part of the chemical precipitation module. If a facility indicated that it was currently transferring the stream to another treatment unit, it was given credit for having the effluent pump in place. Refer to Section 12.3.3 of this document for a more detailed description of the pumps cost module.

Ultrafiltration and microfiltration are considered to provide greater pollutant removals than chemical precipitation (11). Therefore, facilities with ultrafilters or microfilters received treatment-in-place credit for having a complete chemical precipitation system for treatment of all or a portion of their process wastewater, as applicable.

12.3.8 Sludge Dewatering

EPA estimated costs for facilities to dewater the sludge generated by either a DAF or chemical precipitation unit in the DAF, chemical precipitation and Combo options. The sludge dewatering module calculates the costs necessary to pump the sludge through a filter press; remove and dispose of the dewatered cake from the filter; and return the filtrate to the treatment system sump.

Capital and annual costs for the following equipment were included in the sludge dewatering system module:

- A plate and frame filter press system with accessories such as a plate shifter, platform, and cake disposal dumpsters; and

- A positive displacement influent sludge pump.

Direct annual costs included O&M labor and material costs, energy costs, and dewatered cake disposal cost. The capital and annual costs associated with the filter press were based on the required size of the press, which was calculated based on the influent sludge flow rate, solids concentration, and the dewatered cake solids concentration. EPA based solids concentrations for both the sludge and dewatered cake generated by each technology on filter press vendor test data and facility responses to the detailed questionnaire. The filter press was sized based on the volume of dewatered cake that is generated from the sludge stream. The number of batches per day of dewatering was optimized by the module to minimize the size of the filter press, where possible. The volume of cake and the filtrate flow rate were calculated by the sludge dewatering module from a mass balance using the sludge flow rate and the sludge and cake solids concentrations. The additional costs for the filter press system accessories were dependent upon the required size of the filter press. The dewatered cake disposal costs were based on the average reported nonhazardous dewatered cake disposal costs per volume of cake and the module-calculated volume of dewatered cake per year for each facility. The capital and annual costs for the influent sludge pump were calculated based on the required capacity of the pump, which was based on the sludge influent flow rate.

The module is designed to return the filtrate to the facility's trench and sump system, based on typical operating procedures reported by industrial laundries. EPA assumed that the filtrate would flow by gravity from the filter press to the trench and/or sump and therefore would not require any additional collection tanks or transfer pumps. EPA assumed that the returning filtrate would not affect the raw pollutant concentrations in the untreated wastewater because the filtrate volume represents only a small percentage of the volume of the sump. The cost model adjusts the influent flow rate by a factor to account for this slight increase in influent flow rate.

The sludge dewatering module includes an estimate of installation and O&M labor costs for the filter press unit. All labor estimates are based on information obtained from an equipment vendor and engineering judgement. Installation labor for the filter press is estimated by the vendor to be included in an installation cost factor of 75 percent of the purchased cost. The operating labor required for the filter press is estimated by the vendor to be between 30 and 60 minutes per batch. The vendor also estimated an additional two hours per year for maintenance on the press (mostly for changing the filter cloths) (13).

A facility received full sludge dewatering credit if it reported having a sludge dewatering device in place to dewater sludge from a system similar to DAF or chemical precipitation. For example, facilities that reported operating a sludge dewatering device to dewater sludge generated by gravity settling were not given credit for the system. EPA assumed that such a system would not have sufficient capacity to treat the amount of sludge generated by DAF or chemical precipitation units.

The costs for the influent sludge pump to transfer the sludge into and through the filter press, including the necessary installation and operating labor, were also included as part of the sludge dewatering module. If a facility indicated that they were currently dewatering an appropriate amount of sludge, they were given credit for having the influent pump in place. Refer to Section 12.3.3 of this document for a more detailed description of the pumps cost module.

12.3.9 pH Adjustment

EPA estimated costs for facilities to adjust the pH of the effluent wastewater generated by the chemical precipitation options. The pH adjustment module calculates the costs necessary to combine untreated linen supply wastewater and treated industrial laundry wastewater; monitor the pH of the effluent stream; and add necessary chemicals to a mixed tank to adjust the pH of the final effluent stream to within a specified range.

Capital and annual costs for the following equipment were included in the pH adjustment module:

An open, mixed tank;
A pH controller; and
A chemical addition system.

Direct annual costs included O&M labor and material costs, energy cost, and raw material (e.g., sulfuric acid or sodium hydroxide) costs. The capital and annual costs associated with the chemical addition system were based on the required size of the system, which was calculated based on the total influent flow rate and an estimation of the amount of acid or caustic that was required to adjust the final effluent pH to within a specific range. EPA assumed chemical precipitation-treated wastewater to have a pH of 12, based on the average pH observed during sampling episodes. EPA also assumed that untreated light wastewater had a pH of 10, based on sampling data. Based on existing industrial laundry limitations on pH at the point of discharge, EPA assumes that the final effluent pH must be between 5 and 10 upon discharge. Therefore, according to these assumptions, the wastewater generated by the CP options requires pH adjustment prior to discharge in order for facilities to continue to meet their existing pH limits. EPA assumed DAF-treated wastewater to have a pH of 9, based on sampling data. Since the wastewater generated by the DAF options is already within the assumed pH limits, pH adjustment costs are not calculated for these options.

The capital and annual costs associated with the pH adjustment tank were based on the required size of the tank, which was calculated, based on the influent flow rate, to have a three-minute residence time for the wastewater. This is the required residence time to achieve a target pH in a mixed tank with liquid chemical addition (14). The mixer was also costed based on its required size, which was determined based on the size of the pH adjustment tank.

The pH adjustment module calculates the resulting pollutant loads from the combination of the treated and untreated streams. EPA assumed that pH adjustment would not affect the pollutant concentrations in the final effluent. The pH adjustment module calculated the final pollutant loads to be equivalent to those in the pH adjustment influent.

The pH adjustment module includes an estimate of installation and O&M labor costs for the pH adjustment tank and mixer. All labor estimates are based on information obtained from equipment vendors, as well as past effluent guidelines costing efforts and engineering judgement. Installation for the pH adjustment tank and mixer is estimated to take one worker seven hours and 2.4 hours, respectively. The annual O&M labor cost for the equalization tank and mixer is not calculated as a separate item, but included as part of the estimating factor for the annual cost (i.e., five percent of the direct capital cost of the items), based on estimates used in past effluent guidelines efforts (15).

The pH adjustment module also includes installation and O&M labor costs for the chemical feed system. The installation labor and the annual maintenance labor for the chemical feed system were included in the total capital and annual costs, respectively, used from past effluent guidelines costing efforts. The labor hours were not broken out as separate items.

A facility received full pH adjustment treatment-in-place credit if it reported currently using some type of pH adjustment. Costs were estimated for facilities that reported having some of the components of the pH adjustment system to add the necessary parts to complete the system. Facilities did not have to meet a minimum residence time requirement and received treatment-in-place credit for any tank that was available to use for pH adjustment. Facilities that reported using in-line pH adjustment received chemical addition and pH monitoring credit. EPA assumes that adjusting the pH while combining the treated and untreated streams close to the discharge point does not allow for sufficient mixing of the streams and the chemical; thus the target pH would be not be consistently achieved.

12.3.10 Treatment System Building

EPA estimated costs for facilities to construct a building to house the option treatment system. The building module calculates the costs necessary to construct and maintain a building designed to house the option treatment system.

Capital and annual costs for the following equipment were included in the treatment system building:

- A concrete floor slab;
- A concrete curb around the building perimeter;
- A rectangular-shaped, pre-engineered steel frame building; and
- Utilities (plumbing, HVAC, and electricity).

Direct annual costs include costs for labor and materials for the yearly maintenance and repair of the building. These costs were estimated to be 3.5 percent of the direct capital cost (16). The capital cost associated with constructing the building was based on the required size of the building. The square footage requirement of the concrete slab and building, as well as the perimeter length of curbing, were determined for each option based on the equipment space requirements for a low, medium, and large flow of wastewater. Dimensions of various size equipment pieces were gathered from equipment specifications supplied by vendors. The building square footage was calculated by summing each of the option equipment space requirements, allowing for a three- to six-foot clearance between equipment pieces and the building walls. The costs per foot of curbing and costs per square foot of slab and building were both obtained from vendors. All buildings for which costs were calculated by the module included a 16-foot eave height and one 10-foot by 10-foot overhead bay door. All of the installation cost estimates provided by the vendor include the required labor (17).

A facility received full credit for a building in place if they reported having sufficient space currently available in their existing building. These facilities received zero capital and annual costs for a building. Facilities that reported having less than the option's required space or that did not report available space in the detailed questionnaire had costs estimated to construct and maintain a building.

12.3.11 Contact Haul In Lieu of Treatment

EPA assessed the cost of contract hauling wastewater for off-site treatment at a treatment, storage, and disposal facility (TSDF) or a Centralized Waste Treater (CWT) facility compared to the cost of on-site treatment. The equipment included in the industrial laundries treatment options have minimum sizes and capacities. For industrial laundries with low flow rates, it was sometimes found to be less expensive for a facility to have wastewater contract hauled for off-site disposal rather than treat the wastewater on site. To assess contract hauling in lieu of treatment, EPA compared the annualized cost of contract hauling the wastewater to be treated with the annualized cost to treat that wastewater on site for each regulatory option.

Capital and annual costs for the following equipment were included in the contract-haul-in-lieu-of-treatment module:

- Stream splitting costs;
- An influent pump; and
- A wastewater storage tank;

Direct annual costs included operating and maintenance labor and material costs, energy cost, tank sampling costs, and transportation fees. The capital and annual costs for the influent pump and wastewater storage tank are dependent upon the required sizes for each. The tank and pump sizes were calculated by the contract haul module based on the flow rate of the wastewater to be collected and hauled. The tank was sized to hold up to 30 days of wastewater flow. The tank was also 50 percent overdesigned to accommodate fluctuations in facility production. The costs for transportation of the wastewater to the off-site industrial treatment facility were calculated based on the number of trips per year required to haul the wastewater (assuming each trip involves using one 5,000-gallon tank truck to haul the wastewater) and a cost per trip fee provided by a vendor. The cost per gallon to treat the wastewater, as well as the annual tank sampling fee, were also obtained from vendor information.

The contract-haul-in-lieu-of-treatment module includes an estimate of installation and O&M labor costs for the wastewater storage tank and installation of stream-splitting components. All labor estimates are based on information obtained from equipment vendors, as well as past effluent guidelines costing efforts and engineering judgement. Installation labor for the storage tank is estimated by the vendor to take five workers eight hours. The annual O&M labor cost for the tank is not calculated as a separate item, but included as part of the estimating factor for the annual cost (i.e., five percent of the direct capital cost of the tank), based on estimates used by past effluent guidelines efforts. In addition, it was estimated that it would take one facility worker two hours to assist in pumping a 5,000-gallon load of wastewater into the tank truck (18). The installation labor required for the stream-splitting components is described in Section 12.3.2 of this document.

A facility received full tank and/or pump credits if it indicated that a sufficiently sized tank or pump was available on site to transfer and store the wastewater to be hauled. These facilities received zero capital and annual costs for the pump and tank. All facilities with or without equipment credits were costed for the annual sampling, transportation, and treatment costs.

The costs for the influent pump to transfer the wastewater into the storage tank, including the necessary installation and operating labor, were also included as part of the contract-haul-in-lieu-of-treatment module. Refer to Section 12.3.3 of this document for a more detailed description of the pumps cost module.

12.3.12 Compliance Monitoring

EPA calculated annual compliance monitoring costs for all industrial laundry facilities that discharge wastewater. The annual cost calculated by the cost model for compliance monitoring included laboratory costs to analyze composite samples of volatile and semivolatile organics and quantitative metals monthly, and to analyze total petroleum hydrocarbons (measured as silica gel treated-hexane extractable material) once a month collected as four grab samples. The costs for each type of analysis per sample were obtained from a laboratory contracted by EPA on past wastewater sampling efforts. EPA assumed that one worker would be required to spend eight hours per month to collect the samples for analysis. Also included was the cost for glassware and containers needed to package the samples. These costs were obtained from data acquired during the EPA wastewater sampling efforts.

Facilities that reported in the detailed questionnaire that they currently monitor their wastewater were only costed for the analyses. Otherwise, facilities were costed for the analysis, labor, and materials required for the wastewater monitoring. EPA assumed it would take one worker eight hours per month to perform collect the samples (19).

12.4 Engineering Costs by Regulatory Option

Table 12-4 summarizes estimated engineering costs by regulatory option for Pretreatment Standards for Existing Sources (PSES). Costs shown include capital and annual O&M (including energy usage) costs totaled for the 193 in-scope facilities extrapolated to represent the entire industrial laundries industry of 1,747 facilities. In addition, the capital and

O&M costs are shown for 21 in-scope facilities (representing 141 facilities in the industry) which are excluded from the proposed regulation, as discussed in Chapter 6.

Table 12-5 summarizes estimated PSES engineering costs on an amortized yearly basis for the 172 in-scope facilities that are included in the proposed regulation, as discussed in Chapter 6. These costs were extrapolated to represent a total of 1,606 facilities included in the regulation. The methodology used to calculate the amortized annual costs from the capital and annual option costs calculated by the cost model is presented in the EA for the industrial laundries rulemaking (1).

EPA estimates that chemical precipitation is less expensive to operate on an annualized basis than DAF because of much lower operating and maintenance costs for chemical precipitation than for DAF. EPA's performance data show that chemical precipitation achieves better treatment than DAF. In EPA's estimates, facilities that currently operate a DAF would realize an operating and maintenance cost savings for operating a chemical precipitation unit compared to operating a DAF unit. Therefore, EPA's estimated costs for the CP-IL option include operating and maintenance cost credit for facilities that currently operate a DAF to replace the DAF unit with a chemical precipitation unit. EPA's costing analysis for the Combo-IL and Combo-IL-2LIM options assumed that all facilities that already have DAF installed would continue to operate it if given the choice because of constraints on financing (the limits for these options can be achieved by DAF). Since the cost estimates for Combo-IL and Combo-IL-2LIM do not involve replacement of DAF units, there are no operating and maintenance cost credits in these options. For this reason, the Combo-IL and Combo-IL-2LIM options are estimated to be more expensive on an annualized basis than the CP-IL option.

12.5 References

1. U.S. Environmental Protection Agency. Economic Assessment for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category. EPA-821-R-97-005, Washington, DC, November 1997.

2. "Economic Indicators". Chemical Engineering, March 1994, page 182.

3. The Richardson Rapid System Process Plant Construction Estimating Standards. Volume 4: Process Equipment, 1994.

4. U.S. Department of Energy. Monthly Energy Review. DOE/EIA-0035(94/03), March 1994.

Table 12-4

Summary of PSES Engineering Costs

Option	Capital Cost (Million 1993 $s)	O&M Cost (Million $/yr (in 1993 $s))
Capital and Annual Costs for All Industrial Laundries		
DAF-IL	349	131
CP-IL	449	83.4
Combo-IL	421	94.1
Combo-IL-2LIM	349 - 449	83.4 - 131
OC-Only	273	32.2
Capital and Annual Costs for the Excluded Industrial Laundries		
DAF-IL	19.5	5.98
CP-IL	24.1	4.98
Combo-IL	22.2	5.03
Combo-IL-2LIM	19.5 - 24.1	4.98 - 5.98
OC-Only	10.3	0.606

Source: Output from the Industrial Laundries Design and Cost Model, July 15, 1997.

Table 12-5

Summary of PSES Annualized Engineering Costs for Industrial Laundries Included in the Proposed Regulation

Option	Annualized Cost (Million $/yr (in 1993 $s))
DAF-IL	107
CP-IL	85.0
Combo-IL	90.0
Combo-IL-2LIM	85.0 - 107
OC-Only	41.6

Source: Economic Assessment for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category. EPA-821-R-97-005, November 1997.

5. Eastern Research Group, Inc. Stream Splitting Cost Module Documentation for the Industrial Laundries Cost Model. Prepared for the U.S. Environmental Protection Agency, Office of Water, Washington, DC, November 1997.

6. Eastern Research Group, Inc. Pump Cost Module Documentation for the Industrial Laundries Cost Model. Prepared for the U.S. Environmental Protection Agency, Office of Water, Washington, DC, November 1997.

7. Eastern Research Group, Inc. Shaker Screen Cost Module Documentation for the Industrial Laundries Cost Model. Prepared for the U.S. Environmental Protection Agency, Office of Water, Washington, DC, November 1997.

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CHAPTER 13

REGULATORY OPTIONS SELECTION

13.1 Introduction

This chapter summarizes the regulatory options for Pretreatment Standards for Existing Sources (PSES) and Pretreatment Standards for New Sources (PSNS) considered by EPA as the basis for the proposed rule and discusses the factors considered in determining the selected options for PSES and PSNS. Chapter 10 presents all technology options evaluated for the industrial laundries industry and summarizes the factors considered in eliminating from further consideration some of the technology options for PSES and PSNS. Factors considered in developing and selecting the options include: effectiveness of treatment technology, costs to the industry, age of the equipment and facilities involved, the laundering processes used, process changes required, non-water quality environmental impacts, engineering aspects of the control technologies, energy requirements, and ease of option implementation.

The regulatory options selected provide the technology bases for the pretreatment standards for existing and new sources presented in Section 1.3.1 of this document. Owners or operators of facilities subject to these regulations are not required to use the specific wastewater treatment technologies selected by EPA to establish the standards. Rather, a facility can use any combination of process changes, water use changes, and wastewater treatment to comply with the standards, provided that the standards are not achieved through prohibited dilution.

Section 13.2 summarizes the regulatory options considered by EPA, and Section 13.3 presents the rationale for the options selected under PSES and PSNS.

13.2 Regulatory Options Considered

This section discusses the regulatory options considered by EPA as the basis for the industrial laundries proposed rule. Section 13.2.1 presents the regulatory options considered for PSES, and Section 13.2.2 presents the regulatory options considered for PSNS. As discussed in Chapter 10, EPA is not proposing regulations for direct dischargers at this time.

13.2.1 Pretreatment Standards for Existing Sources (PSES)

Pretreatment standards for existing sources establish quantitative limits on the indirect discharge of priority and nonconventional pollutants to waters of the United States (i.e., PSES limit industrial discharges to publicly owned treatment works (POTWs)). PSES are designed to prevent the discharge of pollutants that pass through, interfere with, or are otherwise incompatible with the operation of POTWs. The Clean Water Act (CWA) requires pretreatment for pollutants that pass through POTWs in amounts that would exceed direct discharge effluent limitations or limit POTW sludge management alternatives, including the beneficial use of sludges on agricultural lands. These limits are based upon the performance of specific technologies, but they do not require the use of any specific technology. PSES are applied to individual facilities and are administered by local permitting authorities (i.e., the government entity controlling the POTW to which the industrial wastewater is discharged). The facility then chooses its own approach to complying with its permit limitations.

The regulatory options considered for PSES for the proposed industrial laundries rule are presented in Chapter 10. These five options are summarized in the following table:

Definitions of PSES Regulatory Options Considered for the Industrial Laundries Rule		
Regulatory Option	**Description**	**Basis of Long-Term Average (LTA) Treatment Performance**
DAF-IL	Dissolved air flotation of wastewater from industrial laundry items.	DAF-all
CP-IL	Chemical precipitation of wastewater from industrial laundry items.	CP-all
Combo-IL	Dissolved air flotation or chemical precipitation of wastewater from industrial laundry items. Facilities without treatment are costed for the less expensive technology on an annualized basis.	The higher LTA between DAF-all and CP-all
Combo-IL-2LIM	Dissolved air flotation or chemical precipitation of wastewater from industrial laundry items. Facilities without treatment are costed for chemical precipitation.	DAF-all or CP-all, based on technology costed
OC-Only	Organics control (steam tumbling) of heavy items.	OC-only

13.2.2 Pretreatment Standards for New Sources (PSNS)

Pretreatment standards for new sources are designed to prevent the discharge of pollutants that pass through, interfere with, or are otherwise incompatible with the operation of POTWs. The CWA requires pretreatment for pollutants that pass through POTWs or limit POTW sludge management alternatives. The new source has the opportunity to design and install the best and most efficient industrial laundry processes and wastewater treatment facilities. Accordingly, Congress directed EPA to consider the best demonstrated alternative processes, process changes, in-plant control measures, and end-of-pipe wastewater treatment technologies that reduce pollution to the maximum extent feasible. In response to that directive, EPA considered effluent reductions attainable by the most advanced and demonstrated process and treatment technologies at industrial laundries. The factors considered in assessing PSNS include:

- The demonstration status of the process and wastewater treatment technologies;
- The cost of achieving effluent reductions;
- Non-water quality environmental impacts; and
- Energy requirements.

EPA considered the five regulatory options summarized in the previous section for PSES as the basis for PSNS.

13.3 Final Regulatory Options Selection

This section discusses the regulatory options selected for the industrial laundries proposed rule for PSES and PSNS. Levels of control for direct dischargers are also discussed.

13.3.1 Pretreatment Standards for Existing Sources (PSES)

In selecting the regulatory option for PSES, the Agency determined the total pounds of toxic and nonconventional pollutants (excluding TOC and COD) that would be removed from wastewater discharges from industrial laundries covered by PSES for each regulatory option. (Industrial laundries covered by PSES include facilities processing one million or more pounds of incoming laundry per calendar year and 255,000 or more pounds of shop towels and/or printer towels/rags per calendar year. Industry scope is discussed in detail in Chapter 6.) The Agency also estimated the total compliance cost to the industry for each of the regulatory options. The following table lists the pollutant removals and costs (determined in Chapters 11 and 12, respectively) for industrial laundries covered by PSES for the five regulatory options considered.

Estimated Annualized Costs and Toxic and Nonconventional Pollutant Removals from Industrial Laundry Discharges for Covered Industrial Laundries After Implementing PSES[1]

Option	Estimated Mass of Pollutants Removed Annually Including TPH (thousands of pounds)	Estimated Mass of TPH Removed Annually (thousands of pounds)	Annualized Cost to Industry (millions of 1993 $s)	Option Selected?
DAF-IL	12,578	10,596	107.0	
CP-IL	12,768	10,828	85.0	✓
Combo-IL	12,324	10,596	90.0	
Combo-IL-2LIM	12,578 - 12,768	10,596 - 10,828	85.0 - 107.0	
OC-Only	70	0	41.6	

[1]Data for 1,606 in-scope industrial laundries for which PSES apply.

EPA selected the CP-IL Option for PSES for industrial laundries covered by PSES because it achieves the greatest reduction in pollutants discharged. This option, as discussed in the preamble to the proposed rule, is technically available and represents the best performance economically achievable. Furthermore, the CP-IL Option has acceptable non-water quality environmental impacts.

13.3.2 Pretreatment Standards for New Sources (PSNS)

In selecting the regulatory option for PSNS, the Agency determined the total pounds of pollutants that would be discharged by new industrial laundries for each regulatory option. (EPA is proposing no exclusions by size for new industrial laundries. Industry scope is discussed in detail in Chapter 6.) The Agency also considered the total compliance cost of the proposed PSNS technologies for new facilities for each of the regulatory options. EPA selected the CP-IL Option for PSNS for the reasons mentioned in Section 13.3.1 of this document and discussed in the preamble to the proposed rule.

13.3.3 Direct Dischargers

EPA is reserving effluent limitations guidelines for direct dischargers because EPA has identified no direct dischargers and has no means of evaluating performance to determine the appropriate level of control. Proposed limitations based on pretreatment control technologies would not likely represent best available technology or best available demonstrated technology for direct dischargers because the treatment technologies at existing industrial laundries that EPA evaluated were not designed for treatment prior to discharging directly to surface waters. The type or design (i.e., size) of treatment would not represent BAT because in all cases facilities rely on additional treatment at POTWs. For the pollutants evaluated in this proposed rule, the POTW's biological treatment removed from 4 percent to 99 percent depending on the pollutant. Because EPA has not identified any POTWs receiving a very large proportion of their load (70 to 100 percent) from an industrial laundry, a determination of direct discharge effluent limitations cannot be performed.

EPA is reserving the following direct discharge levels of control: Best Practicable Control Technology Currently Available (BPT), Best Conventional Pollutant Control Technology (BCT), Best Available Technology Economically Achievable (BAT), and New Source Performance Standards (NSPS). If any direct dischargers arise, they would be subject to limitations set on a best professional judgement basis.

CHAPTER 14

NON-WATER QUALITY ENVIRONMENTAL IMPACTS

14.1 Introduction

As required by Sections 304(b) and 306 of the Clean Water Act, EPA considered the non-water quality environmental impacts associated with the implementation of the regulatory options considered as the basis for the proposed PSES and PSNS for the Industrial Laundries Point Source Category. Non-water quality environmental impacts are impacts of the regulatory options on the environment that are not directly associated with wastewater. Specifically, EPA evaluated the potential effect of the CP-IL and DAF-IL regulatory options on energy consumption, air emissions, and solid waste generation of oil and sludge. EPA also considered the impacts of the CP-IL and DAF-IL regulatory options on noise pollution, water usage, and chemical usage. EPA has determined that changes in noise pollution, water usage, and chemical usage from the CP-IL and DAF-IL regulatory options would be acceptable. Because the Combo-IL and Combo-IL-2LIM options involve combinations of the CP-IL and DAF-IL options, the non-water quality environmental impacts for Combo-IL and Combo-IL-2LIM would be within the range of the impacts for CP-IL and DAF-IL. EPA did not evaluate the non-water quality environmental impacts of the OC-Only option.

This chapter presents the non-water quality environmental impacts of the CP-IL and DAF-IL regulatory options and the methodology used by EPA to evaluate impacts on energy consumption, solid waste generation, and air emissions. Specifically, the following information is presented in this chapter:

- Section 14.2 presents the non-water quality environmental impacts associated with the implementation of the CP-IL and DAF-IL regulatory options considered as the basis for PSES for the Industrial Laundries Point Source Category;

- Section 14.3 presents the non-water quality environmental impacts associated with the implementation of the regulatory options considered as the basis for PSNS for the Industrial Laundries Point Source Category; and

- Section 14.4 presents the references used.

14.2 Non-Water Quality Environmental Impacts of the CP-IL and DAF-IL Regulatory Options Considered as the Basis for PSES

EPA evaluated the non-water quality environmental impacts associated with implementation of the CP-IL and DAF-IL regulatory options considered as the basis for PSES for the Industrial Laundries Point Source Category. These options are described in Chapter 10 of this document. Specifically, the following information is presented in this section:

- Section 14.3.1 presents the energy consumption impacts;
- Section 14.3.2 presents the air emission impacts; and
- Section 14.3.3 presents the solid waste impacts.

14.2.1 Energy Consumption Impacts

EPA evaluated energy consumption impacts associated with implementation of the CP-IL and DAF-IL options. Based on this evaluation, EPA estimates that compliance with either of these options would result in a net increase in energy consumption for the industrial laundries industry. To calculate incremental energy increases for the industrial laundries industry, EPA examined the wastewater treatment in place at the industrial laundries that would be covered by the proposed regulation. For the CP-IL and DAF-IL options, EPA used the industrial laundries cost model to calculate the energy that would be required to operate wastewater treatment equipment to be installed at industrial laundries that are not currently operating treatment systems comparable with these options. The industrial laundries cost model is described in Chapter 12. EPA extrapolated the energy increases to represent the entire industrial laundries industry, and estimated the incremental energy increase for the industrial laundries industry as a result of the CP-IL and DAF-IL options. The incremental increases in electricity use from all existing in-scope industrial laundries identified by EPA for the CP-IL and DAF-IL regulatory options are presented in Table 14-1. Table 14-1 also presents the average incremental increase per facility (based on 1,606 in-scope industrial laundries identified by EPA) and the percentage of the national energy requirements represented by the incremental increase for each regulatory option. (Approximately 2,805 billion kilowatt hours of electric power were generated in the United States in 1990(1)).

EPA estimates that the incremental energy increases from the CP-IL and DAF-IL options would be a small percentage of the electricity currently used by the industrial laundries industry to operate all washing, drying, and treatment equipment. Based on this analysis, EPA has determined that energy impacts from the proposed rule would be acceptable. In addition, industrial laundries can offset the energy impacts of installing additional wastewater treatment equipment by reusing treated hot or warm water. This practice results in energy savings for hot water generation. The use of heat reclaimers at industrial laundries for energy conservation is discussed in Chapter 8.

14.2.2 Air Emissions Impacts

Industrial laundry facilities generate wastewater that contains significant concentrations of organic pollutants, some of which are on the list of Hazardous Air Pollutants (HAPs) in Title 3 of the Clean Air Act Amendments (CAAA) of 1990.

Table 14-1

Incremental Energy Increases Associated With Implementation of the CP-IL and DAF-IL Regulatory Options

PSES Regulatory Option Considered for Proposal[1]	Incremental Energy Increases[2]		Percentage of National Energy Requirements[3]
	Total Industry Increase (million kilowatt hours)	Average Increase Per Facility (kilowatt hours)	
DAF-IL	79.9	49,700	0.003%
CP-IL	75.6	47,100	0.003%

[1]Regulatory options are presented in Chapter 10 of this document.
[2]Incremental energy increases are based on 1,606 industrial laundries covered by the proposed rule.
[3]Approximately 2,805 billion kilowatt hours of electric power were generated in the United States in 1990(1).

Atmospheric exposure of the organic-containing wastewater may result in volatilization of HAPs and volatile organic compounds (VOCs) from the wastewater. Emissions from wastewater treatment systems occur at process drains, manholes, trenches, sumps, screens, equalization basins, dissolved air flotation units, chemical precipitation units and at any other locations where the wastewater is in contact with the air.

EPA believes, however, that air emissions from existing industrial laundry wastewater would be similar before and after implementation of the PSES regulatory options considered for proposal. At facilities that do not currently have treatment on site, the wastewater typically flows from the washers to an open or partially open catch basin, then to the sewer and on to the POTW, where the wastewater is typically treated in open aerated basins or lagoons. Air emissions from the wastewater occur as the wastewater flows from the facility to the POTW and at the POTW. At a facility with treatment, the wastewater has more contact with air while still at the facility as it is treated in open tanks and other open treatment units prior to flowing through the sewer to the POTW. Air emissions from the treated wastewater occur at the treatment units at the facility as well as while the wastewater flows to the POTW and at the POTW. EPA believes that the overall amount of air emissions from industrial laundries wastewater would not change as a result of the PSES regulatory options considered for proposal, but that the location of air emissions would shift from the POTW's treatment system to the facility's treatment system.

EPA evaluated total fugitive air emissions for a representative industrial laundry based on a worst-case scenario. EPA considered whether this total amount of fugitive air emissions would be acceptable assuming it represented incremental air emissions due to each of the PSES regulatory options considered for proposal. However, EPA does not believe that the total amount of fugitive emissions calculated represents incremental air emissions because the amount of air emissions would be similar before and after implementation of the rule. EPA's methodology for estimating fugitive air emissions is described below.

As discussed in Chapter 9, EPA collected and analyzed wastewater samples at six industrial laundries operating treatment systems that effectively treated industrial laundry wastewater. These treatment systems are also the basis of the five PSES regulatory options considered for proposal. At all six facilities, total raw wastewater samples were collected. EPA selected the facility with the highest raw wastewater loading of organic pollutants to represent a worst-case scenario. EPA also assumed that all of the organic pollutants in the raw wastewater would volatilize during treatment. EPA believes that this represents a worst-case scenario for all of the PSES regulatory options considered for proposal because not all of the organic pollutants present in the wastewater are volatile, and those that are volatile would not volatilize completely because they are at least somewhat soluble in water. Based on this methodology, the fugitive air emissions calculated by EPA are much higher than would actually occur at an industrial laundry employing wastewater treatment.

EPA used the following formula to calculate annual fugitive emissions of organic pollutants:

$$Y\frac{\text{Mg}}{\text{year}} = \left(X\frac{\text{mg}}{\text{liter}}\right)\left(F\frac{\text{gallons}}{\text{day}}\right)\left(N\frac{\text{days}}{\text{year}}\right)\left(3.785\frac{\text{liters}}{\text{gallon}}\right)\left(\frac{1\ \text{Mg}}{1\ \text{x}\ 10^{9}\ \text{mg}}\right)$$

where

Y = megagrams of organic pollutant volatilized per year;
X = average concentration of the organic pollutant in the wastewater;
F = average daily wastewater flow rate; and
N = average days of operation per year.

Fugitive emissions were calculated for all volatile and semivolatile organic pollutants. If a pollutant was not detected in the raw wastewater sample, EPA used the detection limit concentration to calculate the fugitive air emissions for that pollutant. Using the average daily flow (203,000 gallons per day), average raw wastewater pollutant concentration, and average days of operation (261 days per year), EPA calculated the fugitive air emissions levels presented in Table 14-2. Based on summing the fugitive emissions for each individual HAP, the total annual HAP emissions from this industrial laundry would be 14 Mg/year.

Under the Clean Air Act, major sources of pollution by HAPs are defined as having either:

(1) A total emission of 25 Mg/year or higher for the total of all HAPs from all emission points at a facility; or

(2) An emission of 10 Mg/year or higher for a single HAP from all emission points at a facility.

Based on these criteria, fugitive air emissions from this worst-case industrial laundry would not be classified as a major source of pollution. Based on the assumptions made to evaluate a worst-case scenario, the increases in fugitive air emissions from the PSES regulatory options considered for proposal would be much less than the fugitive air emissions calculated from the worst-case scenario. Because EPA does not believe there would be an overall increase in air emissions and because even a shift of location of air emissions would not render a facility a major source of air pollution, EPA has determined that the incremental fugitive air emissions impacts from the PSES regulatory options considered for proposal are acceptable.

Table 14-2

Fugitive Air Emissions of Organic Pollutants From Industrial Laundry Wastewater -- Analysis of a Worst-Case Scenario

Organic Air Pollutant	Hazardous Air Pollutant?	Raw Wastewater Concentration (mg/L)	Amount Volatilized (Mg/year)
Volatile Organics			
1,1-Dichloroethane	Y	0.14	0.03
1,1,1-Trichloroethane	N	0.42	0.08
1,4-Dioxane	Y	2.59	0.52
2-Butanone	N	0.73	0.15
2-Chloroethylvinyl Ether	N	1.30	0.26
2-Propanone	N	35.79	7.18
4-Methyl-2-pentanone	N	1.66	0.33
Chlorobenzene	Y	0.65	0.13
Ethylbenzene	Y	2.40	0.48
m-Xylene	Y	14.27	2.86
Methylene Chloride	Y	1.55	0.31
o-&*p*-Xylene	Y	6.36	1.28
Tetrachloroethene	N	15.55	3.12
Toluene	Y	13.17	2.64
trans-1,2-Dichloroethene	N	0.04	0.01
Trichloroethene	N	0.04	0.01
Trichlorofluoromethane	N	0.04	0.01
Semivolatile Organics			
1,2-Diphenylhydrazine	Y	0.20	0.04
2,3,6-Trichlorophenol	N	0.10	0.02
2,4,5-Trichlorophenol	Y	0.10	0.02

Table 14-2 (Continued)

Organic Air Pollutant	Hazardous Air Pollutant?	Raw Wastewater Concentration (mg/L)	Amount Volatilized (Mg/year)
2,4,6-Trichlorophenol	Y	0.10	0.02
2,4-Dichlorophenol	N	0.10	0.02
2,4-Dimethylphenol	N	0.10	0.02
2,4-Dinitrophenol	Y	0.50	0.10
2-Chlorophenol	N	0.10	0.02
2-Methylnapthalene	N	0.10	0.02
2-Nitrophenol	N	0.20	0.04
4-Chloro-3-methylphenol	N	0.16	0.03
4-Nitrophenol	Y	0.50	0.10
∝-Terpineol	N	0.10	0.02
Benzoic Acid	N	0.66	0.13
Benzyl Alcohol	N	0.10	0.02
Bis(2-ethylhexyl) Phthalate	Y	19.11	3.83
Bromodichloromethane	N	0.04	0.01
Butyl Benzyl Phthalate	N	0.48	0.10
Diethyl Phthalate	N	0.10	0.02
Dimethyl Phthalate	Y	0.10	0.02
Di-*n*-butyl Phthalate	N	1.23	0.25
Di-*n*-octyl Phthalate	N	0.10	0.02
Hexanoic Acid	N	0.10	0.02
Isophorone	Y	0.10	0.02
Naphthalene	Y	6.43	1.29
n-Decane	N	277.97	55.74
n-Docosane	N	1.74	0.35
n-Dodecane	N	11.13	2.23

Table 14-2 (Continued)

Organic Air Pollutant	Hazardous Air Pollutant?	Raw Wastewater Concentration (mg/L)	Amount Volatilized (Mg/year)
n-Eicosane	N	5.13	1.03
n-Hexacosane	N	1.19	0.24
n-Hexadecane	N	13.47	2.70
n-Nitrosomorpholine	Y	0.10	0.02
n-Octadecane	N	4.73	0.95
n-Tetracosane	N	4.14	0.83
n-Tetradecane	N	11.88	2.38
p-Cymene	N	0.19	0.04
Pentachlorophenol	Y	0.50	0.10
Pentamethylbenzene	N	0.84	0.17
Phenol	Y	0.10	0.02
Phenol, 2-Methyl-4, 6-Dinitro	N	0.20	0.04
Styrene	Y	0.17	0.03
Total for HAPs:			**13.86**

14.2.3 Solid Waste Impacts

To determine the impact of the proposed regulation on solid waste generation, EPA used information provided in the industrial laundries detailed questionnaire responses to estimate the incremental sludge generation from the CP-IL and DAF-IL options. Both of these options involve treatment of industrial laundry wastewater followed by dewatering of the sludge generated during treatment. The dewatered sludge is then disposed. Most industrial laundries responding to the detailed questionnaire reported disposing of their sludge at nonhazardous industrial landfills. To estimate the incremental sludge generation from CP-IL and DAF-IL, EPA subtracted the volume of sludge currently generated by industrial laundries from the estimated volume of sludge that would be generated after implementation of either option.

The volume of sludge currently generated by industrial laundries (in dry solids, pounds per year) was calculated using the industrial laundries cost model for all industrial laundries included in the proposed regulation that currently operate a wastewater treatment system. EPA did not include sludge generation reported from facilities with minimal treatment (i.e., settling pits and screens) in the baseline sludge generation amount. Therefore, the baseline sludge generation is the minimum volume of sludge currently generated and any calculated incremental increases in sludge generation from the CP-IL or DAF-IL options are larger than would actually be observed from implementation of these options.

EPA used the industrial laundries cost model to calculate the volume of sludge that would be generated by the 172 in-scope industrial laundries included in the proposed regulation after implementation of the CP-IL and DAF-IL options. By subtracting the baseline sludge generation volume from the volume of sludge generated after implementation of CP-IL and DAF-IL, EPA determined an incremental sludge generation increase for each of the 172 in-scope industrial laundries included in the proposed regulation. EPA then extrapolated the sludge volumes to account for the 1,606 industrial laundries that would be covered by the proposed rule. Table 14-3 presents the incremental increase in sludge generation (in wet sludge and dry solids) from all existing in-scope industrial laundries identified by EPA for CP-IL and for DAF-IL. Table 14-3 also presents the average incremental increase per industrial laundry and the percentage of the national volume of nonhazardous waste sent to landfills represented by the incremental increase for each regulatory option. (Approximately 430 million tons (dry basis) of industrial nonhazardous waste was sent to landfills in the United States in 1990(2)). Based on this analysis, EPA has determined that the solid waste impacts of the regulatory options consider for proposal are acceptable.

Table 14-3

Incremental Sludge Generation Increases Associated With Implementation of the CP-IL and DAF-IL Regulatory Options

PSES Regulatory Option Considered for Proposal[1]	Incremental Sludge Generation Increases[2]				Percentage of National Volume of Waste Disposed to Non-Hazardous Industrial Landfills[4]
	Total Industry Increase (Tons of Dewatered Sludge)	Total Industry Increase (Tons of Dry Solids)[3]	Average Facility Increase (Tons of Dewatered Sludge)	Average Facility Increase (Tons of Dry Solids)[3]	
DAF-IL	62,200	34,200	38.7	21.3	0.008%
CP-IL	73,500	25,700	45.8	16.0	0.006%

[1]Regulatory options are presented in Chapter 10 of this document.
[2]Incremental sludge generation increases are based on 1,606 industrial laundries covered by the proposed rule.
[3]Industrial laundries responding to the detailed questionnaire that currently treat their wastewater through DAF or chemical precipitation reported an average solids content of their dewatered sludge of 55% and 35%, respectively.
[4]Approximately 430 million tons (dry basis) of industrial nonhazardous waste was sent to landfills in the United States in 1990(2).

14.3 Non-Water Quality Environmental Impacts of the Regulatory Options Considered for PSNS

EPA considered the non-water quality environmental impacts associated with the implementation of the regulatory options considered for PSNS for the Industrial Laundries Point Source Category. Over a three-year period (1991, 1992, and 1993), according to the 1994 Industrial Laundries Industry Detailed Questionnaire, laundry operations began at only about 80 facilities (and it is not absolutely clear from the data whether these facilities were actually new dischargers or were existing dischargers acquired in that year by a different firm). Given the small level of growth in the industrial laundries industry, EPA believes that new sources are primarily replacing production from closing facilities that exit the market. EPA also believes that new sources will incorporate more pollution prevention practices and will recycle more of the wastewater generated at their facilities. Therefore, EPA has determined that the non-water quality environmental impacts associated with the implementation of the regulatory options considered for PSNS will be negligible.

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CHAPTER 15

PRETREATMENT STANDARDS FOR EXISTING SOURCES (PSES) AND PRETREATMENT STANDARDS FOR NEW SOURCES (PSNS)

15.1 Introduction

Pretreatment standards for existing sources establish quantitative limits on the indirect discharge of priority and nonconventional pollutants to waters of the United States. PSES are designed to prevent the discharge of pollutants that pass through, interfere with, or are otherwise incompatible with the operation of publicly owned treatment works (POTWs). The Clean Water Act (CWA) requires pretreatment for pollutants that pass through POTWs in amounts that would exceed direct discharge effluent limitations or limit POTW sludge management alternatives, including the beneficial use of sludges on agricultural lands. EPA also determines that there is pass-through of a pollutant if the pollutant exhibits significant volatilization prior to treatment by POTWs. Pretreatment standards are to be technology-based. The technology selected by the Agency to define the PSES performance for the removal of priority and nonconventional pollutants may include end-of-pipe treatment, process changes, and internal controls.

Pretreatment standards for new sources also establish quantitative limits on the indirect discharge of priority and nonconventional pollutants to waters of the United States. New indirect discharging facilities have the opportunity to incorporate the best available demonstrated technologies, including process changes, in-plant control measures, and end-of-pipe wastewater treatment technologies that reduce pollution to the maximum extent feasible.

The owners or operators of facilities subject to PSES or PSNS are not required to use the specific wastewater treatment technologies selected by the Agency to establish the limitations and standards. Rather, a facility can use any combination of process changes, water use changes, and wastewater treatment to comply with permit limitations and standards, provided that the limitations and standards are not achieved through prohibited dilution.

EPA has selected the CP-IL Option, a regulatory option based on chemical precipitation, as the technology basis for the proposed PSES. The CP-IL Option is based on chemical precipitation treatment of all industrial laundry wastewater for control of wastewater discharges to POTWs from industrial laundry facilities. The proposed standards would be applicable to all wastewater discharged from facilities covered under PSES. EPA finds this option to be the best available treatment performance technology economically achievable based on data collected during the development of the proposed rule. EPA has also selected the CP-IL Option as the proposed technology basis for the proposed PSNS. The rationale behind these selections is discussed in the preamble to the proposed rule and in Chapter 13 of this document.

The following information is presented in this section:

- Section 15.2 reviews the industrial laundries regulated by PSES and PSNS, provides a brief description of EPA's POTW pass-through analysis, discusses pollutants proposed to be regulated by PSES and PSNS, and presents the proposed PSES and PSNS; and

- Section 15.3 discusses PSES and PSNS implementation with regard to point of application, permit limitations, and monitoring and compliance issues.

15.2 <u>Summary of the Proposed PSES and PSNS</u>

15.2.1 Regulated Facilities

PSES and PSNS are proposed for the industrial laundries covered by this rule. As discussed in Section 6.3 of this document, the regulated facilities include facilities that meet the definition of an industrial laundry.

Under PSES, EPA is proposing to exclude existing facilities laundering less than one million pounds of incoming laundry per calendar year and less than 255,000 pounds of shop towels and/or printer towels/rags per calendar year. EPA made this exclusion in order to eliminate unacceptable disproportionate adverse economic impacts on these smaller facilities. If any excluded facility launders one million pounds or more of laundry or more than 255,000 pounds of shop towels and/or printer towels/rags during any calendar year, the facility would no longer be excluded from PSES. See Chapter 6 for a detailed discussion of the scope of the proposed rule.

Under PSNS, EPA proposes that no facilities would be excluded, since the economic projections indicate that there would be no barrier to entry as a result of the new source standards.

15.2.2 POTW Pass-Through Analysis

Based on currently available data and information, EPA evaluated POTW pass-through for those pollutants proposed for regulation (listed in Section 7.4 of this document). In determining whether a pollutant is expected to pass through a POTW, EPA assessed the following:

- Whether the pollutant would be volatilized from conveyance systems, equalization or other treatment units, or POTW head works that are open to the atmosphere;

- Whether the nation-wide average percentage of a pollutant removed by well-operated POTWs achieving secondary treatment is less than the percentage removed by the proposed PSES treatment options; or

- Whether there are any specific instances of POTW interference, upset, or pass-through known to EPA as being caused by the pollutants proposed for regulation.

The uncontrolled transfer of a pollutant from water to air through volatilization does not constitute treatment. Therefore, EPA has determined that for the pollutants proposed for regulation that undergo significant volatilization from conveyance systems, equalization or other treatment units, or POTW head works that are open to the atmosphere, will pass through POTWs and should be regulated by pretreatment standards.

EPA usually determines whether a particular pollutant is passing through a POTW by comparing the average POTW removal with average removal obtained by direct dischargers. Direct dischargers have not been identified to date for the industrial laundries industry. Therefore, EPA determined pass-through for the industrial laundries industry by comparing the average treatment provided by POTWs nationwide (expressed as a percentage removal) to the average treatment provided by the proposed PSES options. Chapter 7 provides a detailed description of the pass-through analysis.

15.2.3 Regulated Pollutants

The pollutants proposed to be regulated by EPA include seven organics, three metals, and one nonconventional bulk parameter, total petroleum hydrocarbons (TPH, measured as silica gel treated-hexane extractable material (SGT-HEM)). Table 15-1 presents the proposed list of regulated pollutants. EPA believes that regulating these 11 pollutants will control the discharge of all pollutants of concern in industrial laundry wastewater. A detailed description of the pollutants proposed for regulation is in Chapter 7.

15.2.4 PSES and PSNS

Table 15-2 presents the proposed PSES and PSNS for the industrial laundries industry. The proposed PSES and PSNS for the industry are based on a combination of long-term average treatment performance concentrations and variability factors that account for day-to-day variation in measured treated effluent concentrations. Long-term average treatment performance concentrations, discussed in Chapter 9, are target values that a facility should achieve on a long-term average basis. The variability factors, also discussed in Chapter 9, represent the ratio of an elevated value that would be expected to occur only rarely to the long-term average. The purpose of the variability factor is to allow for variations in effluent concentrations that comprise the long-term average. A facility that designs and operates its treatment system to achieve a long-term average on a consistent basis should be able to comply with the daily and monthly limitations in the course of normal operations.

Table 15-1

Pollutants Proposed to be Regulated Under PSES and PSNS

Metals
Copper
Lead
Zinc
Organics
Bis(2-ethylhexyl) Phthalate
Ethylbenzene
Naphthalene
Tetrachloroethene
Toluene
m-Xylene
o-&*p*-Xylene
Nonconventional Pollutants
Total Petroleum Hydrocarbons (measured as SGT-HEM)

SGT-HEM - Silica gel treated-hexane extractable material

Table 15-2

Proposed PSES and PSNS for the Industrial Laundries Industry

Pollutant or Pollutant Property	Proposed PSES and PSNS for End-of-Pipe Monitoring Points: Maximum for any 1 day (mg/L)	Proposed PSES and PSNS for End-of-Pipe Monitoring Points: Monthly Average (mg/L)
Copper	0.24	---[1]
Lead	0.27	---[1]
Zinc	0.61	---[1]
Bis(2-ethylhexyl) Phthalate	0.13	---[1]
Ethylbenzene	1.64	---[1]
Naphthalene	0.23	---[1]
Tetrachloroethene	1.71	---[1]
Toluene	2.76	---[1]
m-Xylene[2]	1.33	---[1]
o-&*p*-Xylene[2]	0.95	---[1]
TPH (as SGT-HEM)[3]	27.5	15.4

[1]EPA is not proposing monthly average limitations for these pollutants.
[2]EPA is proposing the use of EPA Methods 1624 and 624 for the analysis of xylenes, even though xylenes are not specifically listed as an analyte in either of these methods (promulgated at 40 CFR Part 136). EPA used data obtained from the analysis of xylenes by these two methods in the development of the proposed industrial laundry standards.
[3]TPH (as SGT-HEM) is total petroleum hydrocarbons measured by the silica gel treated-hexane extractable material analytical method proposed January 23, 1996 (Method 1664).

15.3 Implementation of the PSES and PSNS

15.3.1 Point of Application

PSES and PSNS for wastewaters from industrial laundry operations are applicable at end-of-pipe discharge points, as denoted in Table 15-2, for all pollutants proposed for regulation. The end-of-pipe monitoring point should be located prior to the POTW sewer system. If the facility is treating only part of its stream, the end-of-pipe monitoring point should be located after all process wastewater is commingled.

15.3.2 Permit Limitations

If final PSES and PSNS are promulgated as proposed, EPA expects that permit limitations for pollutants at end-of-pipe discharge points would be concentration-based. Proposed concentration-based limitations are listed in Table 15-2, and are the same for PSES and PSNS. Concentration-based permit limitations offer a direct measure for both the permitting authority and the permitted facility that PSES or PSNS performance levels are being achieved.

To establish daily maximum limitations and monthly average limitations, a permit writer must examine the discharge wastewater streams present at a facility. The permit writer must define the components of the discharged wastewater stream, as discussed in Chapter 3 of the Guidance Manual for the Use of Production-Based Pretreatment Standards and the Combined Wastestream Formula (1).

The proposed concentration-based limitations specified in the categorical standards apply to the discharge of wastewater from regulated processes (i.e., water washing of all items) prior to mixing with unregulated and dilute wastewater streams. Because some facilities may combine regulated and nonregulated streams prior to the discharge location, the combined wastestream formula (CWF) was developed to allow permit writers to calculate alternative pollutant limits at industrial facilities where a regulated wastestream is mixed with other wastestreams, while protecting against inappropriate dilution (see 40 CFR 406(e)). The formula establishes alternative concentration-based or mass-based limits based on the proportionate contribution of each wastestream. The formula divides the universe of wastestreams into three types:

1) Regulated - A wastestream for which a categorical treatment standard has been promulgated;

2) Unregulated - A wastestream that may contain regulated pollutants but for which categorical treatment standards have not been promulgated; and

3) Dilute - A wastestream that contains few or no regulated pollutants.

The unregulated and the dilute wastestreams are referred to as nonregulated streams.

When a regulated wastestream is combined prior to treatment with other wastestreams, the CWF must be used to calculate alternate discharge limits that apply to the combined stream. When a regulated wastestream is combined with other wastestreams after treatment, the CWF may be applied to calculate alternate discharge limits but it is not mandatory.

Equation 15-1, the CWF, presents the methodology used to calculate alternative concentration limits (also see 40 CFR 403.b(e)(1)):

$$C_T = \frac{\sum C_i F_i}{\sum F_i} * \frac{F_T - F_D}{F_T} \qquad 15\text{-}1$$

where:

C_T	=	Alternative concentration limit for the pollutant in the combined wastestream
C_i	=	Concentration-based categorical pretreatment standard for the pollutant in regulated stream i
F_i	=	Average daily flow (at least 30-day average) of regulated stream i
F_D	=	Average daily flow (at least 30-day average) of dilute wastestream(s)
F_T	=	Average daily flow (at least 30-day average) of all wastestreams (including regulated, unregulated, and dilute wastestreams).

If a nonregulated wastestream is combined with a regulated wastestream, after treatment and monitoring occurs after the streams are combined, the flow-weighted average formula may be used instead of the CWF. For concentration-based standards, a flow-proportioning calculation must be performed in order to properly account for the levels of the regulated pollutant in the nonregulated wastestream(s).

Equation 15-2 presents the flow-weighted average formula:

$$C_A = \frac{\sum C_i \times F_i + \sum M_i}{F_T} \qquad 15\text{-}2$$

where:

C_A	=	Adjusted concentration limit for the pollutant in the combined wastestream
C_i	=	Concentration-based categorical pretreatment standard for the pollutant in regulated stream i
F_i	=	Average daily flow (at least 30-day average) of regulated stream i
F_T	=	Average daily flow (at least 30-day average) of all wastestreams (including regulated, unregulated, and dilute wastestreams)
M_i	=	Actual Mass of pollutant in nonregulated wastestreams combined with regulated wastestream after treatment.

Using the formula in this manner will adjust the limitations based on the types (regulated, unregulated, or dilute) of wastestreams and the point where they are combined. If the nonregulated wastestream(s) have high pollutant loadings the adjusted concentration limit will be higher than the categorical standard after implementation of this formula. However, if the pollutant loading is lower in the nonregulated stream than in the regulated stream, the adjusted concentration limit will be lower than the categorical standard. When dilute wastestreams are added, the formula reduces the flow-weighted average in proportion to the flow of the dilute wastestreams. This adjustment is made to prohibit dilution.

If the effluent guidelines for the Industrial Laundries Point Source Category is promulgated as proposed, the combined wastestream formula would be applied in the following manner. The regulated wastestream would consist of process wastewater generated from the water washing of all items. An example of an unregulated wastestream for the Industrial Laundries Point Source Category would be the wastewater stream generated from the dry-cleaning process. A dilute wastestream is defined in 40 CFR Part 403 to include sanitary wastewater, noncontact cooling water, and boiler blowdown.

Table 15-3 provides discharge streams and discharge flows for three example facilities. All examples shown here represent use of the CWF, not the flow-weighted average formula. Example calculations of alternative concentration limits for three proposed regulated pollutants for the three facilities are presented below.

Facility One

Facility One has one regulated wastewater stream. The CWF does not need to be applied in this instance. The limits for this facility are those presented in Table 15-2.

Table 15-3

Alternative Concentration-Based Limits for Example Facilities

Wastestream[1]	Average Daily Flow (gal/day)	Example Pollutants	Concentration-based Categorical Pretreatment Standard (mg/L)	Alternative Concentration Limit (Derived from CWF, mg/L)
Facility One				
Process Flow	20,000	TPH Copper Naphthalene	27.5 0.24 0.23	--- --- ---
Total Flow = Process Flow	20,000	TPH Copper Naphthalene	27.5 0.24 0.23	Not Applicable Not Applicable Not Applicable
Facility Two				
Wastestream[1]	**Average Daily Flow (gal/day)**	**Example Pollutants**	**Concentration-based Categorical Pretreatment Standard (mg/L)**	**Alternative Concentration Limit (Derived from CWF, mg/L)**
Process Flow	20,000	TPH Copper Naphthalene	27.5 0.24 0.23	--- --- ---
Noncontact Cooling Water	2,000	None	---	---
Total Flow = Process Flow + Noncontact Cooling Water	22,000	TPH Copper Naphthalene	27.5 0.24 0.23	25.00 0.22 0.21
Facility Three				
Wastestream[1]	**Average Daily Flow (gal/day)**	**Example Pollutants**	**Concentration-based Categorical Pretreatment Standard (mg/L)**	**Alternative Concentration Limit (Derived from CWF, mg/L)**
Process Flow from Water Washing Shop Towels	20,000	TPH Copper Naphthalene	27.5 0.24 0.23	--- --- ---
Dry-cleaning Flow	10,000	TPH Copper Naphthalene	--- --- ---	--- --- ---
Total Flow = Process Flow from Shop Towels + Dry-cleaning Flow	30,000	TPH Copper Naphthalene	27.5 0.24 0.23	27.5 0.24 0.23

[1]At this facility, streams are combined prior to treatment.

The permit writer must compare the concentration of the pollutants in the discharge stream to the limits presented in Table 15-2; if the concentration measured in the discharge is less than the limit, then the facility is in compliance.

Facility Two

Facility Two has two wastewater streams, a regulated stream (process flow) and a dilution stream (noncontact cooling water). These streams are combined prior to treatment; therefore, the CWF must be applied. As shown in Table 15-3, the following flow data were used for the calculation.

F_i (process flow)	= 20,000 gal/day
F_D (noncontact cooling water flow)	= 2,000 gal/day
F_T (total flow)	= 22,000 gal/day

Equation 15-1 is then applied using the flow data as well as the concentration-based limits from Table 15-2. An example calculation of the alternative daily maximum concentration for copper is shown as follows:

$$C_T = \frac{0.24 \text{ mg/L} * 20{,}000 \text{ gal/day}}{20{,}000 \text{ gal/day}} * \frac{22{,}000 \text{ gal/day} - 2{,}000 \text{ gal/day}}{22{,}000 \text{ gal/day}}$$

$$C_T = 0.218 \text{ mg/L}$$

The alternative maximum daily limits for all other regulated pollutants would be calculated in a similar manner. After calculating the alternative limits, the permit writer would compare the measured concentrations in the discharge stream to the alternative limits. The facility would be in compliance if the measured concentrations in the discharge stream are lower than the alternative limits.

Facility Three

Facility Three has two wastestreams, a regulated stream (process flow from shop towels) and an unregulated wastestream (flow from dry-cleaning processes). These streams are combined prior to treatment; therefore, the CWF must be applied. It should be noted that, when the CWF is applied to a facility combining an unregulated steam with a regulated stream, the alternative concentration limit of a pollutant will be equal to that of the concentration-based categorical pretreatment standard for that pollutant. This is due to the fact that unregulated streams are presumed, for the purposes of the CWF, to contain pollutants of concern at concentrations equivalent to the regulated stream. Rather than treating the unregulated flow as dilution, which would result in lowering the allowable concentration of a pollutant, the CWF allows the pollutant to be discharged in the unregulated wastestream at the same concentration as the standard for the regulated wastestream that is being discharged. Pollutants that are present in the unregulated wastestream are presumed to be treated to the same level as the regulated wastestream.

As shown in Table 15-3, the following flow data were used for the calculation:

F_i (process flow) = 20,000 gal/day
F_D (dilution flow) = 0 gal/day
F_T (total flow) = 30,000 gal/day

Equation 15-1 is then applied using the flow data as well as the concentration-based limits from Table 15-2. An example calculation of the daily maximum concentration for copper is shown as follows:

$$C_T = \frac{0.24\ \text{mg/L} * 20{,}000\ \text{gal/day}}{20{,}000\ \text{gal/day}} * \frac{30{,}000\ \text{gal/day} - 0\ \text{gal/day}}{30{,}000\ \text{gal/day}}$$

$$C_T = 0.24$$

The maximum daily limits for all other regulated pollutants would be calculated in a similar manner. After calculating the maximum daily limits, the permit writer would compare the measured concentration in the discharge stream to the calculated maximum daily limits. If the measured concentration in the discharge stream is lower than the calculated maximum daily limits, then the facility is in compliance.

15.3.3 Monitoring and Compliance

The limitations are provided as daily maximums and monthly averages for TPH (measured as SGT-HEM) and as daily maximums for all other regulated pollutants. Monitoring was assumed to occur four times per month for TPH and one time per month for all other regulated pollutants. Compliance with the daily maximum discharge limit is required, regardless of the number of samples analyzed. EPA-approved analytical methods for analyzing the regulated pollutants are shown in Table 15-4.

15.4 References

1. U.S. Environmental Protection Agency. Guidance Manual for the Use of Production-Based Pretreatment Standards and the Combined Wastestream Formula. September 1985.

Table 15-4

EPA-Approved Analytical Methods for Analyzing the Regulated Pollutants[1]

Pollutant	EPA Analytical Method
Copper	200.7, 220.2, 1620[2]
Lead	200.7, 239.1, 239.2, 1620[2]
Zinc	200.7, 289.1, 289.2, 1620[2]
Bis(2-ethylhexyl) Phthalate	606, 625, 1625
Ethylbenzene	602, 624, 1624
Naphthalene	610, 625, 1625
Tetrachloroethene	601, 624, 1624
Toluene	602, 624, 1624
m-Xylene	624, 1624[3]
o-&*p*-Xylene	624, 1624[3]
Total Petroleum Hydrocarbons (measured as SGT-HEM)	1664[4]

[1]This table shows EPA methods only. Except for total petroleum hydrocarbons measured as silica gel treated-hexane extractable material (SGT-HEM) and xylenes, methods for monitoring these pollutants are specified at 40 CFR Part 136. The CFR also specifies methods published by voluntary consensus standards bodies, when available.
[2]Although not specifically listed at 40 CFR Part 136, EPA Method 1620 is a consolidation of methods 200.7, 204.2, 206.2, 239.2, 270.2, 279.2, 245.5, 245.1, and 245.2. EPA used data obtained from the analysis of metals and elements by Method 1620.
[3]EPA is proposing the use of EPA Methods 1624 and 624 for the analysis of xylenes. Xylenes are not specifically listed as an analyte in either of these methods (promulgated at 40 CFR Part 136). EPA used data obtained from the analysis of xylenes by these two methods in the development of the proposed industrial laundries standards.
[4]Total Petroleum Hydrocarbon (measured as SGT-HEM) is total petroleum hydrocarbons measured by the silica gel treated-hexane extractable material analytical method proposed January 23, 1996 (Method 1664).

CHAPTER 16

GLOSSARY OF TERMS

Absorbents: Substance used to absorb leaks, spills, and sprays around machinery and workstations. Oil, coolants, solvents, and water are common materials absorbed.

Administrator: The Administrator of the U.S. Environmental Protection Agency.

Annually: For purposes of the exclusion, annually would mean per calendar year.

Agency: The U.S. Environmental Protection Agency.

BAT: The best available technology economically achievable, as described in section 304(b)(2) of the Clean Water Act.

BCT: The best conventional pollutant control technology, as described in section 304(b)(4) of the Clean Water Act.

Bench-scale operation: Laboratory testing of materials, methods, or processes on a small scale, such as on a laboratory worktable.

BMP or BMPs: Best management practice(s), as described in section 304(e) of the Clean Water Act or as authorized by section 402 of the CWA.

BOD_5: Five-day biochemical oxygen demand. A measure of biochemical decomposition of organic matter in a water sample. It is determined by measuring the dissolved oxygen consumed by microorganisms to oxidize the organic contaminants in a water sample under standard laboratory conditions of five days and 20°C. BOD_5 is not related to the oxygen requirements in chemical combustion.

BPT: The best practicable control technology currently available, as described in section 304(b)(1) of the Clean Water Act.

Buffing pads: Used to polish floors.

CAA: Clean Air Act. The Air Pollution Prevention and Control Act (42 U.S.C. 7401 et. seq.), as amended, inter alia, by the Clean Air Act Amendments of 1990 (Public Law 101-549, 104 Stat. 2399).

CEB: Chemical emulsion breaking.

CFR: Code of Federal Regulations, published by the U.S. Government Printing Office. A codification of the general and permanent rules published in the Federal Register by the Executive departments and agencies of the federal government.

Clean room garments: Used in particle- and static-free environments by computer manufacturing, pharmaceutical, biotechnology, aerospace, and other customers to control contamination in production areas.

CN: Abbreviation for total cyanide.

COD: Chemical oxygen demand (COD) - A nonconventional bulk parameter that measures the total oxygen-consuming capacity of wastewater. This parameter is a measure of materials in water or wastewater that are biodegradable and materials that are resistant (refractory) to biodegradation. Refractory compounds slowly exert demand on downstream receiving water resources. Certain of the compounds measured by this parameter have been found to have carcinogenic, mutagenic, and similar adverse effects, either singly or in combination. It is expressed as the amount of oxygen consumed by a chemical oxidant in a specific test.

Contract hauling: The removal of any waste stream from the plant or facility by a company authorized to transport and dispose of the waste, excluding discharges to sewers or surface waters.

Control authority: (1) The POTW if the POTW's submission for its pretreatment program (§403.3(t)(1)) has been approved in accordance with the requirements of §403.11; or (2) the approval authority if the submission has not been approved.

Conventional pollutants: Constituents of wastewater as determined in section 304(a)(4) of the Clean Water Act and the regulations thereunder (i.e., biochemical oxygen demand (BOD_5), total suspended solids (TSS), oil and grease, fecal coliform, and pH).

Cooperative: An enterprise or organization owned by and operated for the benefit of those using its services. For purposes of this rule, a laundry serving like facilities owned by and/or operated for the benefit of those facilities.

CP: Chemical precipitation.

CWA: Clean Water Act. The Federal Water Pollution Control Act Amendments of 1972 (33 U.S.C. 1251 et seq.).

DAF: Dissolved air flotation.

Daily discharge: The discharge of a pollutant measured during any calendar day or any 24-hour period.

Denim prewash: Washing of denim material or manufactured denim items prior to sale to soften the fabric and/or alter its appearance. This is achieved through use of chemicals and processes such as stone, acid, and ice washing.

Detailed Questionnaire: 1994 Industrial Laundries Questionnaire. A questionnaire sent by EPA to collect detailed technical and economic information from industrial laundry and linen facilities for the 1993 operating year, under authority of section 308 of the Clean Water Act. The questionnaire was sent to those facilities likely to be affected by promulgation of effluent limitations guidelines, pretreatment standards, and new source performance standards for their industry.

DMQ: 1995 Detailed Monitoring Questionnaire. A questionnaire sent by EPA to 37 industrial laundries based on responses to the detailed questionnaire that requested available monitoring data for 1993.

Direct discharger: The discharge of a pollutant or pollutants directly to a water of the United States with or without treatment by the discharger.

Dry cleaning: The cleaning of fabrics using an organic-based solvent rather than water-based detergent solution.

Dual-phase washing: The dry cleaning and water washing of laundry items in series without drying the items between the solvent and water phases.

Effluent: Wastewater discharges.

EPA: The U.S. Environmental Protection Agency.

Facility: A facility is all contiguous property owned, operated, leased or under control of the same person, or corporate or business entity. The contiguous property may be divided by public or private right-of-way.

Fender covers: Used in the automobile repair and services industry to protect the fenders of automobiles from oil, grease, dirt, and other damage.

FR: Federal Register, published by the U.S. Government Printing Office, Washington, D.C. A publication making available to the public regulations and legal notices issued by federal agencies.

HAPS: Hazardous air pollutants.

Hazardous waste: Any material that meets the Resource Conservation and Recovery Act definition of "hazardous waste" contained in 40 CFR Part 261.

Health care items: Items such as hospital gowns, linen, and towels used in hospitals, doctors' offices, and dentists' offices.

HEM: Hexane extractable material. A method-defined parameter that measures the presence of relatively nonvolatile hydrocarbons, vegetable oils, animal fats, waxes, soaps, greases, and related material that are extractable in the solvent n-hexane. This parameter does not include materials that volatilize at temperatures below 85°C (see Method 1664). HEM has been proposed to replace the conventional pollutant oil and grease for EPA survey and monitoring programs under the Clean Water Act.

Household laundry: Items that are "noncommercially" owned or are domestic in nature. These items may range from clothing to small rugs.

Indirect discharge: The discharge of a pollutant or pollutants to a publicly owned treatment works (POTW) with or without pretreatment by the discharger.

Industrial laundry (IL): Any facility that launders industrial textile items from off site as a business activity (i.e., launders industrial textile items for other business entities for a fee or through a cooperative agreement). Either the industrial facility or the off-site customer may own the industrial laundered textile items; this includes textile rental companies that perform laundering operations.

Industrial textile items: Items such as, but not limited to industrial: shop towels, printer towels/rags, furniture towels, rags, mops, mats, rugs, tool covers, fender covers, dust-control items, gloves, buffing pads, absorbents, uniforms, filters, and clean room garments.

Inorganic wastewater treatment chemicals: Inorganic chemicals that are commonly used in wastewater treatment systems to aid in the removal of pollutants through physical/chemical technologies such as chemical precipitation, flocculation, neutralization, chemical oxidation, hydrolysis, and/or adsorption.

Laundering: Washing items with water, including water washing following dry cleaning.

Linen: Items such as sheets, pillow cases, blankets, bath towels and washcloths, hospital gowns and robes, tablecloths, napkins, tableskirts, kitchen textile items, continuous roll towels, laboratory coats, family laundry, executive wear, mattress pads, incontinence pads, and diapers. This list is intended to be an all inclusive.

Linen flatwork/full dry: Items such as napkins, tablecloths, and sheets.

LTA: Long-term average. For purposes of the pretreatment standards, average pollutant levels achieved over a period of time by a facility, subcategory, or technology option. LTAs were used in developing the standards in the industrial laundries proposed rule.

Minimum level: The level at which an analytical system gives recognizable signals and an acceptable calibration point.

Miscellaneous not our goods (NOG): Items that are commercially owned by an outside company. Industrial laundries do not always know the breakdown of these items.

New source: As defined in 40 CFR 122.2, 122.29, and 403.3 (k), a new source is any building, structure, facility, or installation from which there is or may be a discharge of pollutants, the construction of which commenced (1) for purposes of compliance with New Source Performance Standards, after the promulgation of such standards under CWA section 306; or (2) for the purposes of compliance with Pretreatment Standards for New Sources, after the publication of proposed standards under CWA section 307(c), if such standards are thereafter promulgated in accordance with that section.

Noncontact cooling water: Water used for cooling which does not come into direct contact with any raw material, intermediate product, by-product, waste product, or finished product. This term is not intended to relate to air conditioning systems.

Non-water quality environmental impact: An environmental impact of a control or treatment technology, other than to surface waters.

Noncontinuous or intermittent discharge: Discharge of wastewaters stored for periods of at least 24 hours and released on a batch basis.

Nonconventional pollutants: Pollutants that are neither conventional pollutants nor toxic pollutants listed at 40 CFR Section 401.

Nondetect value: A concentration-based measurement reported below the minimum level that can reliably be measured by the analytical method for the pollutant.

NPDES: The National Pollutant Discharge Elimination System, a federal program requiring industry dischargers, including municipalities, to obtain permits to discharge pollutants to the nation's water, under section 402 of the CWA.

NRDC: Natural Resources Defense Council.

NSPS: New source performance standards. This term refers to standards for new sources under section 306 of the CWA.

OC: Organics control.

Off-site: "Off-site" means outside the boundaries of the facility.

On-site: "On-site" means within the boundaries of the facility.

Oil and grease (O&G): A method-defined parameter that measures the presence of relatively nonvolatile hydrocarbons, vegetable oils, animal fats, waxes, soaps, greases, and related materials that are extractable in Freon 113 (1,1,2-trichloro-1,2,2-trifluoroethane). This parameter does not include materials that volatilize at temperatures below 75 C (see Method 413.1). The hexane extractable material (HEM) method has been proposed to replace O&G for EPA survey and monitoring programs under the Clean Water Act.

P2: Pollution prevention.

Pilot-scale: The trial operation of processing equipment which is the intermediate stage between laboratory experimentation and full-scale operation in the development of a new process or product.

PM: Particulate matter.

Point source category: A category of sources of water pollutants that are included within the definition of "point source" in section 502(14) of the CWA.

Pollutant (to water): Dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, certain radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste discharged into water. See CWA Section 502(6); 40 CFR 122.2.

POTW or POTWs: Publicly owned treatment works. A treatment works as defined by Section 212 of the CWA, which is owned by a state or municipality (as defined by Section 502(4) of the Act). This definition includes any devices and systems used in the storage, treatment, recycling and reclamation of municipal sewage or industrial wastes of a liquid nature. It also includes sewers, pipes, and other conveyances only if they convey wastewater to a POTW Treatment Plant. The term also means the municipality as defined in Section 502(4) of the CWA, which has jurisdiction over the indirect discharges to and the discharges from such a treatment works.

PPA: Pollution Prevention Act of 1990 (42 U.S.C. 13101 et seq., Pub.L. 101-508, November 5, 1990).

Pretreatment standard: A regulation specifying industrial wastewater effluent quality required for discharge to a POTW.

Printer towel/rag: Towels used to clean solvents, inks, or soils from various objects or to wipe up spilled solvents and other liquids until they are saturated. They are commonly used in publishing and printing shops.

Priority pollutants: The toxic pollutants listed in 40 CFR Part 423, Appendix A.

Process wastewater collection system: A piece of equipment, structure, or transport mechanism used in conveying or storing a process wastewater stream. Examples of process wastewater collection system equipment include individual drain systems, wastewater tanks, surface impoundments, and containers.

PSES: Pretreatment standards for existing sources of indirect discharges, under section 307(b) of the CWA.

PSNS: Pretreatment standards for new sources of indirect discharges, under section 307(b) and (c) of the CWA.

RCRA: Resource Conservation and Recovery Act of 1976, as amended (42 U.S.C. 6901, et seq.).

RREL: Risk Reduction Engineering Laboratory.

Reuse: The use in laundry operations of all or part of a waste stream produced by an operation which would otherwise be disposed of, whether or not the stream is treated prior to reuse, and whether the reused waste stream is fed to the same operation or to another operation.

RFA: The Regulatory Flexibility Act as amended by SBREFA (5 U.S.C. 60 et seq.).

Rewash items: Items that require a second washing to be in an acceptable state for return to the customer.

Screener questionnaire: Four different two-page questionnaires mailed by EPA to facilities in the laundries industry to develop the scope of the industrial laundries regulation, identify the population of the industrial laundries industry, and select facilities to receive the more detailed questionnaire.

SBA: Small Business Administration.

SBREFA: Small Business Regulatory Enforcement Fairness Act of 1996 (P.L. 104-121, March 29, 1996).

Septic system: A system which collects and treats wastewater, particularly sanitary sewage. The system is usually composed of a septic tank which settles and anaerobically degrades solid waste, and a drainfield which relies on soil to adsorb or filter biological contaminants. Solid wastes are periodically pumped out of the septic tank and hauled to off-site disposal.

SGT-HEM: Silica gel treated-hexane extractable material. A method-defined parameter that measures the presence of mineral oils that are extractable in the solvent n-hexane and not adsorbed by silica gel. This parameter does not include materials that volatilize at temperatures below 85 C (see Method 1664). SGT-HEM is proposed to replace the nonconventional pollutant total petroleum hydrocarbons for EPA survey and monitoring programs under the Clean Water Act.

Shop towel: Towels used to clean oil and grease or soils from various objects or to wipe up oil and grease and other liquids until they are saturated. They are commonly used in machine shops, automotive repair shops, and gas stations.

SIC: Standard Industrial Classification. A numerical categorization system used by the U.S. Department of Commerce to denote segments of industry. An SIC code refers to the principal product, or group of products, produced or distributed, or to services rendered by an operating establishment. SIC codes are used to group establishments by the primary activity in which they are engaged.

Small business: Businesses with annual revenues less than $10.5 million. This is the higher of the two Small Business Administration definitions of small businesses for SIC codes 7218 and 7213.

Source reduction: The reduction or elimination of waste generation at the source, usually within a process. Any practice that: 1) reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the environment (including fugitive emissions) prior to recycling, treatment, or disposal; and 2) reduces the hazards to public health and the environment associated with the release of such substances, pollutants, or contaminants.

Toxic pollutants: The pollutants designated by EPA as toxic in 40 CFR Part 401.15. Also known as priority pollutants.

TPH: Total petroleum hydrocarbons. A method-defined parameter that measures the presence of mineral oils that are extractable in Freon 113 (1,1,2-trichloro-1,2,2-trifluoroethane) and not absorbed by silica gel. This parameter does not include materials that volatilize at temperatures below 70°C (see Method 418.1). Silica gel treated-hexane extractable material (SGT-HEM) has been proposed to replace TPH for EPA survey and monitoring programs under the Clean Water Act.

TRSA: Textile Rental Services Association of America.

TSCA: Toxic Substances Control Act (15 U.S.C. 2601 et seq.)

TSS: Total suspended solids.

UTSA: Uniform and Textile Service Association.

Variability factor: The daily variability factor is the ratio of the estimated 99th percentile of the distribution of daily values divided by the expected value, median or mean, of the distribution of the daily data. The monthly variability factor is the estimated 95th percentile of the distribution of the monthly averages of the data divided by the expected value of the monthly averages.

VOCs: Volatile organic compounds.

Water washing: The process of washing laundry items in which water is the solvent used.

Waters of the United States: The same meaning set forth in 40 CFR 122.2.

Wet air pollution or odor pollution control system scrubbers: Any equipment using water or water mixtures to control emissions of dusts, odors, volatiles, sprays, or other air pollutants.

Zero discharge: No discharge of process wastewater pollutants to waters of the United States or to a POTW.

Appendix A

Tables Referenced in Chapter 3

Table A-1

Metal and Elemental Constituents Measured Under the Industrial Laundries Sampling Program
(EPA Method 1620)

Metal and Elemental Constituents		
Aluminum	Cobalt	Selenium
Antimony	Copper	Silver
Arsenic	Iron	Sodium
Barium	Lead	Thallium
Beryllium	Magnesium	Tin
Boron	Manganese	Titanium
Cadmium	Mercury	Vanadium
Calcium	Molybdenum	Yttrium
Chromium	Nickel	Zinc
Additional Metal and Elemental Constituents[1] Not Subject to Rigorous QA/QC Procedures Per Method 1620:		
Bismuth	Lanthanum	Samarium
Cerium	Lithium	Scandium
Dysprosium	Lutetium	Silicon
Erbium	Neodymium	Strontium
Europium	Niobium	Sulfur
Gadolinium	Osmium	Tantalum
Gallium	Palladium	Tellurium
Germanium	Phosphorus	Terbium
Gold	Platinum	Thorium
Hafnium	Potassium	Thulium
Holmium	Praseodymium	Tungsten
Indium	Rhenium	Uranium
Iodine	Rhodium	Ytterbium
Iridium	Ruthenium	Zirconium

[1]Analyses for these metals and elements were used for screening purposes, and the metals were not selected for regulation in this rulemaking.

Table A-2

Organic Constituents Measured Under the Industrial Laundries Sampling Program (EPA Methods 1624 and 1625)

Volatile Organic Constituents (EPA Method 1624)	
Acrylonitrile	Trans-1,4-dichloro-2-butene
Benzene	Tribromomethane
Bromodichloromethane	Trichloroethene
Bromomethane	Trichlorofluoromethane
Carbon Disulfide	Vinyl Acetate
Chloroacetonitrile	Vinyl Chloride
Chlorobenzene	1,1-dichloroethane
Chloroethane	1,1-dichloroethene
Chloroform	1,1,1-trichloroethane
Chloromethane	1,1,1,2-tetrachloroethane
Cis-1,3-dichloropropene	1,1,2-trichloroethane
Crotonaldehyde	1,1,2,2-tetrachloroethane
Dibromochloromethane	1,2-dibromoethane
Dibromomethane	1,2-dichloroethane
Diethyl Ether	1,2-dichloropropane
Ethyl Cyanide	1,2,3-trichloropropane
Ethyl Methacrylate	1,3-butadiene, 2-chloro
Ethylbenzene	1,3-dichloropropane
Iodomethane	1,4-dioxane
Isobutyl Alcohol	2-butanone
M-xylene	2-chloroethyl vinyl ether
Methyl Methacrylate	2-hexanone
Methylene Chloride	2-propanone
O+p Xylene	2-propen-1-ol
Tetrachloroethene	2-propenal
Tetrachloromethane	2-propenenitrile, 2-methyl-
Toluene	3-chloropropene
Trans-1,2-dichloroethene	4-methyl-2-pentanone
Trans-1,3-dichloropropene	

Table A-2 (Continued)

Semivolatile Organic Constituents (EPA Method 1625)	
Acenaphthene	Fluoranthene
Acenaphthylene	Hexachlorobenzene
Acetophenone	Hexachlorobutadiene
Alpha-terpineol	Hexachlorocyclopentadiene
Aniline	Hexachloroethane
Aniline, 2,4,5-trimethyl-	Hexachloropropene
Anthracene	Hexanoic Acid
Aramite	Indeno(1,2,3-cd)pyrene
Benzanthrone	Isophorone
Benzenethiol	Isosafrole
Benzidine	Longifolene
Benzo(a)anthracene	Malachite Green
Benzo(a)pyrene	Mestranol
Benzo(b)fluoranthene	Methapyrilene
Benzo(ghi)perylene	Methyl Methanesulfonate
Benzo(k)fluoranthene	N-decane
Benzoic Acid	N-docosane
Benzonitrile, 3,5-dibromo-4-hydroxy-	N-dodecane
Benzyl Alcohol	N-eicosane
Beta-naphthylamine	N-hexacosane
Biphenyl	N-hexadecane
Biphenyl, 4-nitro	N-nitrosodi-n-butylamine
Bis(2-chloroethoxy)methane	N-nitrosodiethylamine
Bis(2-chloroethyl) ether	N-nitrosodimethylamine
Bis(2-chloroisopropyl) ether	N-nitrosodiphenylamine
Bis(2-ethylhexyl) phthalate	N-nitrosomethylethylamine
Butyl benzyl phthalate	N-nitrosomethylphenylamine
Carbazole	N-nitrosomorpholine
Chrysene	N-nitrosopiperidine
Ciodrin	N-octacosane
Crotoxyphos	N-octadecane
Di-n-butyl phthalate	N-tetracosane
Di-n-octyl phthalate	N-tetradecane
Di-n-propylnitrosamine	N-triacontane
Dibenzo(a,h)anthracene	N,n-dimethylformamide
Dibenzofuran	Naphthalene
Dibenzothiophene	Nitrobenzene
Diethyl Phthalate	O-anisidine
Dimethyl Phthalate	O-cresol
Dimethyl Sulfone	O-toluidine
Diphenyl Ether	O-toluidine, 5-chloro-
Diphenylamine	P-chloroaniline
Diphenyldisulfide	P-cresol
Ethane, Pentachloro-	P-cymene
Ethyl Methanesulfonate	P-dimethylaminoazobenzene
Ethylenethiourea	P-nitroaniline

Table A-2 (Continued)

Semivolatile Organic Constituents (EPA Method 1625) (Continued)	
Pentachlorobenzene	1,4-naphthoquinone
Pentachlorophenol	1,5-naphthalenediamine
Pentamethylbenzene	2-(Methylthio)benzothiazole
Perylene	2-chloronaphthalene
Phenacetin	2-chlorophenol
Phenanthrene	2-isopropylnaphthalene
Phenol	2-methylbenzothioazole
Phenol, 2-methyl-4,6-dinitro-	2-methylnaphthalene
Phenothiazine	2-nitroaniline
Pronamide	2-nitrophenol
Pyrene	2-phenylnaphthalene
Pyridine	2-picoline
Resorcinol	2,3-benzofluorene
Safrole	2,3-dichloroaniline
Squalene	2,3-dichloronitrobenzene
Styrene	2,3,4,6-tetrachlorophenol
Thianaphthene	2,3,6-trichlorophenol
Thioacetamide	2,4-dichlorophenol
Thioxanthe-9-one	2,4-dimethylphenol
Toluene, 2,4-diamino-	2,4-dinitrophenol
Triphenylene	2,4-dinitrotoluene
Tripropyleneglycol Methyl Ether	2,4,5-trichlorophenol
1-bromo-2-chlorobenzene	2,4,6-trichlorophenol
1-bromo-3-chlorobenzene	2,6-di-tert-butyl-p-benzoquinone
1-chloro-3-nitrobenzene	2,6-dichloro-4-nitroaniline
1-methylfluorene	2,6-dichlorophenol
1-methylphenanthrene	2,6-dinitrotoluene
1-naphthylamine	3-methylcholanthrene
1-phenylnaphthalene	3-nitroaniline
1,2-dibromo-3-chloropropane	3,3'-dichlorobenzidine
1,2-dichlorobenzene	3,3'-dimethoxybenzidine
1,2-diphenylhydrazine	3,6-dimethylphenanthrene
1,2,3-trichlorobenzene	4-aminobiphenyl
1,2,3-trimethoxybenzene	4-bromophenyl Phenyl Ether
1,2,4-trichlorobenzene	4-chloro-2-nitroaniline
1,2,4,5-tetrachlorobenzene	4-chloro-3-methylphenol
1,2:3,4-diepoxybutane	4-chlorophenyl Phenyl Ether
1,3-dichloro-2-propanol	4-nitrophenol
1,3-dichlorobenzene	4,4'-methylenebis(2-chloroaniline)
1,3,5-trithiane	4,5-methylene Phenanthrene
1,4-dichlorobenzene	5-nitro-o-toluidine
1,4-dinitrobenzene	7,12-dimethylbenz(a)anthracene

Table A-3

Additional Parameters Measured in the Industrial Laundries Sampling Program

Parameter	EPA Method
Biochemical Oxygen Demand (BOD_5)	405.1[1]
Chemical Oxygen Demand (COD)	410.1[1] 410.2[1]
Hexane Extractable Material (oil and grease)	1664 (proposed)[2]
pH	150.1[1]
Phosphorus, Total	365.2[1]
Silica Gel Treated-Hexane Extractable Material (total petroleum hydrocarbons)	1664 (proposed)[2]
Surfactants	5540C, 5540D[3]
Total Solids	160.3[1]
Total Hydrolyzable Phosphorus	365.2[1]
Total Organic Carbon	415.1[1]
Total Orthophosphate	365.2[1]
Total Suspended Solids (TSS)	160.2[1]

[1]U.S. Environmental Protection Agency. Methods for Chemical Analysis of Water and Wastes. EPA-800-4-79-020, Revised March 1983.

[2]U.S. Environmental Protection Agency. Method 1664: N-Hexane Extractable Material (HEM) and Silica Gel Treated N-Hexane Extractable Material (SGT-HEM) by Extraction and Gravimetry (Oil and Grease and Total Petroleum Hydrocarbons). EPA-821-B-94-004b, April 1995.

[3]Standard Methods for the Examination of Water and Wastewater. A.D. Eaton, L.S. Clesceri and A.E. Greenberg, eds. 19th Edition. American Public Health Association, Washington, D.C., 1995.

Appendix B

Tables Referenced in Chapter 5

Table B-1

Wastewater Characterization for Item Specific Wastewater at Industrial Laundries

Industrial Garments						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Conventionals						
Biochemical Oxygen Demand 5-Day (BOD_5)	218	600	386	4	4	100
Oil and Grease (measured as HEM)	19	116	91	4	4	100
Total Suspended Solids (TSS)	154	524	348	4	4	100
Priority Organics						
1,1,1-Trichloroethane	0.0100	0.100	0.0550	4	0	0
1,2-Diphenylhydrazine	0.0200	0.200	0.110	4	0	0
4-Chloro-3-methylphenol	0.0100	0.504	0.178	4	1	25
Bis(2-ethylhexyl) Phthalate	0.100	0.352	0.224	4	3	75
Butyl Benzyl Phthalate	0.0100	0.100	0.0550	4	0	0
Chlorobenzene	0.0100	0.100	0.0550	4	0	0
Chloroform	0.0100	0.100	0.0550	4	0	0
Di-*n*-butyl Phthalate	0.0100	0.100	0.0550	4	0	0
Di-*n*-octyl Phthalate	0.0114	0.100	0.0600	4	2	50
Ethylbenzene	0.0100	0.482	0.151	4	1	25
Isophorone	0.0100	0.100	0.0550	4	0	0
Methylene Chloride	0.0100	0.100	0.0558	4	1	25
Naphthalene	0.0100	0.100	0.0550	4	0	0
Phenol	0.0257	0.127	0.0702	4	3	75
Tetrachloroethene	0.0100	0.100	0.0550	4	0	0
Toluene	0.0100	0.128	0.0666	4	2	50
trans-1,2-Dichloroethene	0.0100	0.100	0.0550	4	0	0
Trichloroethene	0.0100	0.100	0.0550	4	0	0
Nonconventional Organics						
2-Butanone	0.0500	0.500	0.275	4	0	0

Table B-1 (Continued)

Industrial Garments						
	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
Constituent Name	Minimum	Maximum	Mean			
2-Methylnaphthalene	0.0100	0.100	0.0550	4	0	0
2-Propanone	0.0500	0.5000	0.313	4	1	25
4-Methyl-2-pentanone	0.0500	0.500	0.275	4	0	0
∝-Terpineol	0.0100	0.100	0.0550	4	0	0
Benzoic Acid	0.374	0.500	0.450	4	2	50
Benzyl Alcohol	0.0396	0.100	0.0699	4	2	50
Hexanoic Acid	0.0728	0.100	0.0885	4	2	50
m-Xylene	0.0100	0.0100	0.0100	2	0	0
n-Decane	0.0100	0.100	0.0550	4	0	0
n-Docosane	0.0118	0.111	0.0632	4	3	75
n-Dodecane	0.0100	0.100	0.0630	4	1	25
n-Eicosane	0.0140	0.100	0.0694	4	2	50
n-Hexacosane	0.0190	0.226	0.130	4	4	100
n-Hexadecane	0.0100	0.100	0.0759	4	1	25
n-Octacosane	0.0167	0.220	0.0956	4	4	100
n-Octadecane	0.0100	0.147	0.0471	4	3	75
n-Tetracosane	0.0188	0.100	0.0679	4	2	50
n-Tetradecane	0.0100	0.100	0.0634	4	1	25
n-Triacontane	0.0177	0.100	0.0620	4	2	50
o-&*p*-Xylene	0.0100	0.0100	0.0100	2	0	0
p-Cresol	0.0100	0.100	0.0550	4	0	0
p-Cymene	0.0100	0.186	0.0764	4	1	25
Pentamethylbenzene	0.0100	0.100	0.0550	4	0	0
Priority Metals and Elements						
Antimony	0.0182	1.57	0.454	4	4	100
Arsenic	0.00110	0.0232	0.0116	4	1	25
Beryllium	0.000420	0.00100	0.000758	4	2	50
Cadmium	0.00500	0.0387	0.0246	4	3	75
Chromium	0.0159	0.161	0.0936	4	4	100

Table B-1 (Continued)

Industrial Garments						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Copper	0.148	1.31	0.672	4	4	100
Lead	0.0460	0.316	0.214	4	3	75
Mercury	0.000200	0.000760	0.000408	4	2	50
Nickel	0.0180	0.164	0.103	4	3	75
Selenium	0.000500	0.0200	0.0102	4	0	0
Silver	0.00230	0.0188	0.00710	4	1	25
Thallium	0.00100	0.0100	0.00360	4	0	0
Zinc	0.264	3.07	1.47	4	4	100
Nonconventional Metals and Elements						
Aluminum	3.20	8.73	5.19	4	4	100
Barium	0.0404	0.560	0.254	4	4	100
Boron	0.0306	0.369	0.195	4	4	100
Cobalt	0.00230	0.0461	0.0171	4	1	25
Iron	1.42	15.4	9.70	4	4	100
Manganese	0.0732	0.205	0.139	4	4	100
Molybdenum	0.00450	0.0539	0.0213	4	2	50
Tin	0.0266	0.267	0.0922	4	3	75
Titanium	0.0842	0.223	0.148	4	4	100
Vanadium	0.00200	0.0120	0.00700	4	0	0
Yttrium	0.000300	0.00400	0.00215	4	0	0
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	1,070	2,760	1,740	4	4	100
Total Organic Carbon (TOC)	163	540	359	4	4	100
Total Petroleum Hydrocarbon (measured as SGT-HEM)	5	74	47	4	4	100

Table B-1 (Continued)

Shop Towels						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Conventionals						
Biochemical Oxygen Demand 5-Day (BOD_5)	1,130	3,310	2,060	5	5	100
Oil and Grease (measured as HEM)	2,090	3,020	2,550	3	3	100
Total Suspended Solids (TSS)	2,540	6,730	4,590	3	3	100
Priority Organics						
1,1,1-Trichloroethane	0.0180	38.3	5.16	5	3	60
1,2-Diphenylhydrazine	0.0700	2.00	1.36	3	0	0
4-Chloro-3-methylphenol	0.0200	2.06	1.03	3	1	33
Bis(2-ethylhexyl) Phthalate	0.633	9.44	3.30	4	3	75
Butyl Benzyl Phthalate	0.0350	1.00	0.678	3	0	0
Chlorobenzene	0.0100	1.00	0.313	4	1	25
Chloroform	0.0100	1.00	0.370	3	0	0
Di-*n*-butyl Phthalate	0.0350	1.00	0.678	3	0	0
Di-*n*-octyl Phthalate	0.0350	1.00	0.678	3	0	0
Ethylbenzene	0.556	36.0	6.25	5	5	100
Isophorone	0.0350	1.00	0.678	3	0	0
Methylene Chloride	0.0307	39.9	5.28	5	3	60
Naphthalene	0.329	5.16	2.88	4	3	75
Phenol	0.0350	1.00	0.381	3	1	33
Tetrachloroethene	0.170	55.5	8.03	5	4	80
Toluene	1.11	11.6	4.81	4	4	100
trans-1,2-Dichloroethene	0.0100	1.00	0.456	4	1	25
Trichloroethene	0.0100	1.00	0.294	4	1	25
Nonconventional Organics						
2-Butanone	0.0898	5.00	1.92	3	2	67
2-Methylnaphthalene	0.627	1.21	0.946	3	2	67
2-Propanone	1.00	5.95	3.98	3	2	67
4-Methyl-2-pentanone	0.132	5.00	1.88	3	1	33
∝-Terpineol	0.0350	1.59	0.874	3	1	33

Table B-1 (Continued)

Shop Towels						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Benzoic Acid	0.301	5.00	3.23	3	2	67
Benzyl Alcohol	0.0350	1.00	0.678	3	0	0
Hexanoic Acid	0.0200	1.00	0.373	3	0	0
m-Xylene	0.884	2.49	1.69	2	2	100
n-Decane	4.70	154	49.5	4	4	100
n-Docosane	0.313	1.54	0.949	3	2	67
n-Dodecane	13.3	23.7	18.2	3	3	100
n-Eicosane	1.44	84.6	29.8	3	3	100
n-Hexacosane	0.470	4.01	1.83	3	2	67
n-Hexadecane	2.85	17.4	9.85	4	4	100
n-Octacosane	0.118	2.21	1.11	3	2	67
n-Octadecane	1.06	22.1	11.4	4	4	100
n-Tetracosane	0.328	1.16	0.831	3	2	67
n-Tetradecane	6.51	36.8	16.9	3	3	100
n-Triacontane	0.0689	1.71	0.926	3	2	67
o-&*p*-Xylene	0.482	0.645	0.563	2	2	100
p-Cresol	0.0200	1.00	0.373	3	0	0
p-Cymene	0.0350	8.11	2.54	4	1	25
Pentamethylbenzene	0.0350	1.00	0.678	3	0	0
Priority Metals and Elements						
Antimony	0.0973	0.369	0.211	5	5	100
Arsenic	0.00800	0.0511	0.0238	4	3	75
Beryllium	0.00100	0.00100	0.00100	3	0	0
Cadmium	0.105	0.856	0.391	5	5	100
Chromium	0.119	1.17	0.478	5	5	100
Copper	2.44	9.79	6.65	5	5	100
Lead	2.04	20.5	7.34	5	5	100
Mercury	0.000200	0.00350	0.00122	4	2	50
Nickel	0.175	1.61	0.600	5	5	100

Table B-1 (Continued)

Shop Towels						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Selenium	0.0100	0.0200	0.0138	3	1	33
Silver	0.00300	0.877	0.174	5	3	60
Thallium	0.00100	0.0120	0.00467	3	0	0
Zinc	6.82	29.4	13.9	5	5	100
Nonconventional Metals and Elements						
Aluminum	5.57	19.3	11.3	5	5	100
Barium	0.730	10.3	3.98	5	5	100
Boron	0.0500	3.81	1.81	5	4	80
Cobalt	0.0720	0.795	0.336	5	5	100
Iron	24.6	114	55.2	5	5	100
Manganese	0.510	1.95	1.18	5	5	100
Molybdenum	0.153	1.27	0.351	5	5	100
Tin	0.0290	0.808	0.270	5	4	80
Titanium	0.0177	0.574	0.199	5	5	100
Vanadium	0.0106	0.113	0.0433	5	5	100
Yttrium	0.00320	0.0171	0.00810	3	3	100
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	7,700	26,300	14,000	5	5	100
Total Organic Carbon (TOC)	750	2950	1,950	5	5	100
Total Petroleum Hydrocarbon (measured as SGT-HEM)	520	3410	1,630	3	3	100

Table B-1 (Continued)

Printer Towels						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Conventionals						
Biochemical Oxygen Demand 5-Day (BOD_5)	3,360	4,250	3,940	3	3	100
Oil and Grease (measured as HEM)	936	11,800	5,890	3	3	100
Total Suspended Solids (TSS)	810	1,600	1,250	3	3	100
Priority Organics						
1,1,1-Trichloroethane	1.00	8.26	4.50	3	2	67
1,2-Diphenylhydrazine	0.200	2.000	1.00	3	0	0
4-Chloro-3-methylphenol	0.100	1.00	0.433	3	0	0
Bis(2-ethylhexyl) Phthalate	3.83	36.4	19.0	3	3	100
Butyl Benzyl Phthalate	1.00	9.34	5.55	3	2	67
Chlorobenzene	0.100	1.00	0.467	3	1	33
Chloroform	0.0100	1.00	0.370	3	0	0
Di-*n*-butyl Phthalate	0.844	7.75	3.20	3	2	67
Di-*n*-octyl Phthalate	0.100	2.61	1.24	3	1	33
Ethylbenzene	0.521	29.2	13.2	3	3	100
Isophorone	0.100	1.00	0.500	3	0	0
Methylene Chloride	0.140	1.54	0.614	3	3	100
Naphthalene	3.73	12.7	9.64	3	3	100
Phenol	0.100	1.00	0.500	3	0	0
Tetrachloroethene	2.40	6.16	3.92	3	3	100
Toluene	14.1	33.2	20.5	3	3	100
trans-1,2-Dichloroethene	0.0118	1.00	0.371	3	1	33
Trichloroethene	0.100	1.00	0.476	3	1	33
Nonconventional Organics						
2-Butanone	2.05	5.00	3.09	3	2	67
2-Methylnaphthalene	0.100	1.71	0.836	3	2	67
2-Propanone	23.4	96.6	49.7	3	3	100
4-Methyl-2-pentanone	0.500	5.00	2.07	3	1	33
∝-Terpineol	0.100	1.58	1.07	3	2	67

Table B-1 (Continued)

Printer Towels						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Benzoic Acid	1.50	5.00	3.30	3	2	67
Benzyl Alcohol	0.100	1.00	0.500	3	0	0
Hexanoic Acid	0.100	1.00	0.433	3	0	0
m-Xylene	0.100	2.79	1.44	2	1	50
n-Decane	10.1	158	90.6	3	3	100
n-Docosane	0.100	1.00	0.668	3	1	33
n-Dodecane	12.9	41.8	23.1	3	3	100
n-Eicosane	1.22	1.38	1.29	3	3	100
n-Hexacosane	1.00	3.73	2.01	3	2	67
n-Hexadecane	4.34	15.4	9.51	3	3	100
n-Octacosane	0.100	1.01	0.402	3	1	33
n-Octadecane	1.73	3.62	2.43	3	3	100
n-Tetracosane	0.100	1.00	0.605	3	1	33
n-Tetradecane	3.08	15.8	7.89	3	3	100
n-Triacontane	0.100	1.00	0.626	3	1	33
o-&*p*-Xylene	0.100	2.05	1.08	2	1	50
p-Cresol	0.100	1.00	0.433	3	0	0
p-Cymene	8.10	19.8	12.4	3	3	100
Pentamethylbenzene	0.1000	1.00	0.500	3	0	0
Priority Metals and Elements						
Antimony	0.0200	0.104	0.0556	3	2	67
Arsenic	0.00100	0.00530	0.00313	3	2	67
Beryllium	0.00100	0.00100	0.00100	3	0	0
Cadmium	0.0129	0.0444	0.0253	3	3	100
Chromium	0.278	7.31	2.65	3	3	100
Copper	8.20	14.9	11.0	3	3	100
Lead	1.12	23.8	8.91	3	3	100
Mercury	0.000200	0.000290	0.000230	3	1	33
Nickel	0.0962	0.108	0.101	3	3	100

Table B-1 (Continued)

Printer Towels						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Selenium	0.0100	0.0230	0.0177	3	0	0
Silver	0.00900	0.555	0.207	3	3	100
Thallium	0.00100	0.0120	0.00767	3	0	0
Zinc	2.84	4.21	3.62	3	3	100
Nonconventional Metals and Elements						
Aluminum	3.30	17.4	8.22	3	3	100
Barium	3.14	6.97	4.53	3	3	100
Boron	0.614	0.777	0.670	3	3	100
Cobalt	0.222	0.942	0.614	3	3	100
Iron	5.58	10.0	8.51	3	3	100
Manganese	0.305	1.29	0.898	3	3	100
Molybdenum	0.328	5.17	2.10	3	3	100
Tin	0.0431	0.138	0.0990	3	3	100
Titanium	0.0797	0.313	0.184	3	3	100
Vanadium	0.00700	0.0120	0.00900	3	0	0
Yttrium	0.00400	0.00810	0.00570	3	1	33
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	15,800	19,100	16,900	3	3	100
Total Organic Carbon (TOC)	2,220	3,520	2,740	3	3	100
Total Petroleum Hydrocarbon (measured as SGT-HEM)	133	4,540	1,730	3	3	100

Table B-1 (Continued)

Mats						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Conventionals						
Biochemical Oxygen Demand 5-Day (BOD_5)	248	248	248	1	1	100
Oil and Grease (measured as HEM)	84	84	84	1	1	100
Total Suspended Solids (TSS)	365	365	365	1	1	100
Priority Organics						
1,1,1-Trichloroethane	1.60	1.60	1.60	1	1	100
1,2-Diphenylhydrazine	0.0200	0.0200	0.0200	1	0	0
4-Chloro-3-methylphenol	0.0100	0.0100	0.0100	1	0	0
Bis(2-ethylhexyl) Phthalate	2.02	2.02	2.02	1	1	100
Butyl Benzyl Phthalate	0.0197	0.0197	0.0197	1	1	100
Chlorobenzene	0.0100	0.0100	0.0100	1	0	0
Chloroform	0.0100	0.0100	0.0100	1	0	0
Di-*n*-butyl Phthalate	0.0100	0.0100	0.0100	1	0	0
Di-*n*-octyl Phthalate	0.0494	0.0494	0.0494	1	1	100
Ethylbenzene	0.283	0.283	0.283	1	1	100
Isophorone	0.361	0.361	0.361	1	1	100
Methylene Chloride	0.442	0.442	0.442	1	1	100
Naphthalene	0.0244	0.0244	0.0244	1	1	100
Phenol	0.0100	0.0100	0.0100	1	0	0
Tetrachloroethene	0.125	0.125	0.125	1	1	100
Toluene	1.29	1.29	1.29	1	1	100
trans-1,2-Dichloroethene	0.0100	0.0100	0.0100	1	0	0
Trichloroethene	0.0100	0.0100	0.0100	1	0	0
Nonconventional Organics						
2-Butanone	0.579	0.579	0.579	1	1	100
2-Methylnaphthalene	0.0100	0.0100	0.0100	1	0	0
2-Propanone	2.11	2.11	2.11	1	1	100
4-Methyl-2-pentanone	0.458	0.458	0.458	1	1	100
∝-Terpineol	0.0825	0.0825	0.0825	1	1	100

Table B-1 (Continued)

Mats						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Benzoic Acid	0.231	0.231	0.231	1	1	100
Benzyl Alcohol	0.0724	0.0724	0.0724	1	1	100
Hexanoic Acid	0.0737	0.0737	0.0737	1	1	100
m-Xylene	0.520	0.520	0.520	1	1	100
n-Decane	1.98	1.98	1.98	1	1	100
n-Docosane	0.0130	0.0130	0.0130	1	1	100
n-Dodecane	0.121	0.121	0.121	1	1	100
n-Eicosane	0.0166	0.0166	0.0166	1	1	100
n-Hexacosane	0.0197	0.0197	0.0197	1	1	100
n-Hexadecane	0.0305	0.0305	0.0305	1	1	100
n-Octacosane	0.0100	0.0100	0.0100	1	0	0
n-Octadecane	0.0152	0.0152	0.0152	1	1	100
n-Tetracosane	0.0100	0.0100	0.0100	1	0	0
n-Tetradecane	0.0190	0.0190	0.0190	1	1	100
n-Triacontane	0.0306	0.0306	0.0306	1	1	100
o-&*p*-Xylene	0.291	0.291	0.291	1	1	100
p-Cresol	0.0100	0.0100	0.0100	1	0	0
p-Cymene	0.0100	0.0100	0.0100	1	0	0
Pentamethylbenzene	0.0100	0.0100	0.0100	1	0	0
Priority Metals and Elements						
Antimony	0.0203	0.0203	0.0203	1	1	100
Arsenic	0.00380	0.00380	0.00380	1	0	0
Beryllium	0.00100	0.00100	0.00100	1	0	0
Cadmium	0.00950	0.00950	0.00950	1	1	100
Chromium	0.0806	0.0806	0.0806	1	1	100
Copper	0.220	0.220	0.220	1	1	100
Lead	0.307	0.307	0.307	1	1	100
Mercury	0.000430	0.000430	0.000430	1	1	100
Nickel	0.0543	0.0543	0.0543	1	1	100

Table B-1 (Continued)

Mats						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Selenium	0.00460	0.00460	0.00460	1	0	0
Silver	0.0171	0.0171	0.0171	1	1	100
Thallium	0.0120	0.0120	0.0120	1	0	0
Zinc	1.06	1.06	1.06	1	1	100
Nonconventional Metals and Elements						
Aluminum	3.42	3.42	3.42	1	1	100
Barium	0.214	0.214	0.214	1	1	100
Boron	0.0500	0.0500	0.0500	1	0	0
Cobalt	0.0135	0.0135	0.0135	1	1	100
Iron	6.87	6.87	6.87	1	1	100
Manganese	0.115	0.115	0.115	1	1	100
Molybdenum	0.0240	0.0240	0.0240	1	1	100
Tin	0.0439	0.0439	0.0439	1	1	100
Titanium	0.0100	0.0100	0.0100	1	0	0
Vanadium	0.00920	0.00920	0.00920	1	1	100
Yttrium	0.00500	0.00500	0.00500	1	0	0
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	80	80	80	1	1	100
Total Organic Carbon (TOC)	186	186	186	1	1	100
Total Petroleum Hydrocarbon (measured as SGT-HEM)	33	33	33	1	1	100

Table B-1 (Continued)

Mops						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Conventionals						
Biochemical Oxygen Demand 5-Day (BOD_5)	140	2,160	1,150	2	2	100
Oil and Grease (measured as HEM)	9	564	286	2	2	100
Total Suspended Solids (TSS)	332	1,860	1,100	2	2	100
Priority Organics						
1,1,1-Trichloroethane	0.0100	2.08	1.04	2	1	50
1,2-Diphenylhydrazine	0.200	0.200	0.200	2	0	0
4-Chloro-3-methylphenol	0.100	0.100	0.100	2	0	0
Bis(2-ethylhexyl) Phthalate	1.08	1.13	1.10	2	2	100
Butyl Benzyl Phthalate	0.166	1.62	0.895	2	2	100
Chlorobenzene	0.0100	0.100	0.0550	2	0	0
Chloroform	0.0130	0.100	0.0565	2	1	50
Di-*n*-butyl Phthalate	0.100	0.768	0.434	2	1	50
Di-*n*-octyl Phthalate	0.100	0.116	0.108	2	1	50
Ethylbenzene	0.0100	0.100	0.0550	2	0	0
Isophorone	0.100	0.100	0.100	2	0	0
Methylene Chloride	0.0100	0.143	0.0767	2	1	50
Naphthalene	0.443	0.500	0.471	2	2	100
Phenol	0.100	0.100	0.100	2	0	0
Tetrachloroethene	0.0100	0.100	0.0550	2	0	0
Toluene	0.0194	0.100	0.0597	2	1	50
trans-1,2-Dichloroethene	0.0100	0.100	0.0550	2	0	0
Trichloroethene	0.0100	0.100	0.0550	2	0	0
Nonconventional Organics						
2-Butanone	0.0500	2.21	1.13	2	1	50
2-Methylnaphthalene	0.100	0.763	0.432	2	1	50
2-Propanone	0.0500	4.40	2.22	2	1	50
4-Methyl-2-pentanone	0.0500	0.500	0.275	2	0	0
∝-Terpineol	0.100	0.100	0.100	2	0	0

Table B-1 (Continued)

Mops						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Benzoic Acid	1.91	2.78	2.35	2	2	100
Benzyl Alcohol	0.100	1.12	0.610	2	1	50
Hexanoic Acid	0.185	0.246	0.216	2	2	100
m-Xylene	0.100	0.100	0.100	1	0	0
n-Decane	0.271	1.66	0.965	2	2	100
n-Docosane	0.137	0.178	0.157	2	2	100
n-Dodecane	0.100	16.0	8.07	2	1	50
n-Eicosane	0.246	0.336	0.291	2	2	100
n-Hexacosane	0.207	0.213	0.210	2	2	100
n-Hexadecane	0.286	1.86	1.07	2	2	100
n-Octacosane	0.168	0.275	0.221	2	2	100
n-Octadecane	0.392	1.36	0.875	2	2	100
n-Tetracosane	0.100	0.100	0.100	2	0	0
n-Tetradecane	1.13	1.80	1.47	2	2	100
n-Triacontane	0.0941	0.232	0.163	2	2	100
o-&*p*-Xylene	0.100	0.100	0.100	1	0	0
p-Cresol	0.100	0.100	0.100	2	0	0
p-Cymene	0.100	0.100	0.100	2	0	0
Pentamethylbenzene	0.100	0.100	0.100	2	0	0
Priority Metals and Elements						
Antimony	0.0556	0.0556	0.0556	1	1	100
Arsenic	0.0178	0.0178	0.0178	1	1	100
Beryllium	0.00100	0.00100	0.00100	1	0	0
Cadmium	0.0373	0.0373	0.0373	1	1	100
Chromium	0.184	0.184	0.184	1	1	100
Copper	3.52	3.52	3.52	1	1	100
Lead	1.76	1.76	1.76	1	1	100
Mercury	0.00840	0.00840	0.00840	1	1	100
Nickel	0.195	0.195	0.195	1	1	100

Table B-1 (Continued)

Mops						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Selenium	0.00460	0.00460	0.00460	1	0	0
Silver	0.0160	0.0160	0.0160	1	1	100
Thallium	0.00240	0.00240	0.00240	1	0	0
Zinc	5.32	5.32	5.32	1	1	100
Nonconventional Metals and Elements						
Aluminum	17.3	17.3	17.3	1	1	100
Barium	0.953	0.953	0.953	1	1	100
Boron	0.327	0.327	0.327	1	1	100
Cobalt	0.0620	0.0620	0.0620	1	1	100
Iron	31.9	31.9	31.9	1	1	100
Manganese	0.638	0.638	0.638	1	1	100
Molybdenum	0.0940	0.0940	0.0940	1	1	100
Tin	0.128	0.128	0.128	1	1	100
Titanium	0.307	0.307	0.307	1	1	100
Vanadium	0.0320	0.0320	0.0320	1	1	100
Yttrium	0.00500	0.00500	0.00500	1	0	0
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	720	10,100	5,410	2	2	100
Total Organic Carbon (TOC)	133	902	518	2	2	100
Total Petroleum Hydrocarbon (measured as SGT-HEM)	5	218	111	2	1	50

Table B-1 (Continued)

Steam-Tumbled Printer Towels						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Conventionals						
Biochemical Oxygen Demand 5-Day (BOD_5)	1,440	1,440	1,440	1	1	100
Oil and Grease (measured as HEM)	1,720	1,720	1,720	1	1	100
Total Suspended Solids (TSS)	1,320	1,320	1,320	1	1	100
Priority Organics						
1,1,1-Trichloroethane	0.0118	0.0118	0.0118	1	1	100
1,2-Diphenylhydrazine	0.0800	0.0800	0.0800	1	0	0
4-Chloro-3-methylphenol	0.0400	0.0400	0.0400	1	0	0
Bis(2-ethylhexyl) Phthalate	8.77	8.77	8.77	1	1	100
Butyl Benzyl Phthalate	0.366	0.366	0.366	1	1	100
Chlorobenzene	0.0100	0.0100	0.0100	1	0	0
Chloroform	0.0100	0.0100	0.0100	1	0	0
Di-*n*-butyl Phthalate	0.117	0.117	0.117	1	1	100
Di-*n*-octyl Phthalate	0.325	0.325	0.325	1	1	100
Ethylbenzene	0.0100	0.0100	0.0100	1	0	0
Isophorone	0.0400	0.0400	0.0400	1	0	0
Methylene Chloride	0.0100	0.0100	0.0100	1	0	0
Naphthalene	0.226	0.226	0.226	1	1	100
Phenol	0.0432	0.0432	0.0432	1	1	100
Tetrachloroethene	0.0100	0.0100	0.0100	1	0	0
Toluene	0.0436	0.0436	0.0436	1	1	100
trans-1,2-Dichloroethene	0.0100	0.0100	0.0100	1	0	0
Trichloroethene	0.0100	0.0100	0.0100	1	0	0
Nonconventional Organics						
2-Butanone	0.0500	0.0500	0.0500	1	0	0
2-Methylnaphthalene	0.0400	0.0400	0.0400	1	0	0
2-Propanone	0.681	0.681	0.681	1	1	100
4-Methyl-2-pentanone	0.0500	0.0500	0.0500	1	0	0
∝-Terpineol	0.0400	0.0400	0.0400	1	0	0

Table B-1 (Continued)

Steam-Tumbled Printer Towels						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Benzoic Acid	0.977	0.977	0.977	1	1	100
Benzyl Alcohol	0.819	0.819	0.819	1	1	100
Hexanoic Acid	0.384	0.384	0.384	1	1	100
m-Xylene	0.0151	0.0151	0.0151	1	1	100
n-Decane	0.499	0.499	0.499	1	1	100
n-Docosane	0.131	0.131	0.131	1	1	100
n-Dodecane	2.65	2.65	2.65	1	1	100
n-Eicosane	3.05	3.05	3.05	1	1	100
n-Hexacosane	0.0904	0.0904	0.0904	1	1	100
n-Hexadecane	91.6	91.6	91.6	1	1	100
n-Octacosane	0.0633	0.0633	0.0633	1	1	100
n-Octadecane	1.48	1.48	1.48	1	1	100
n-Tetracosane	0.0724	0.0724	0.0724	1	1	100
n-Tetradecane	12.8	12.8	12.8	1	1	100
n-Triacontane	0.0587	0.0587	0.0587	1	1	100
o-&*p*-Xylene	0.0146	0.0146	0.0146	1	1	100
p-Cresol	0.0400	0.0400	0.0400	1	0	0
p-Cymene	0.0400	0.0400	0.0400	1	0	0
Pentamethylbenzene	0.0400	0.0400	0.0400	1	0	0
Priority Metals and Elements						
Antimony	0.0261	0.0261	0.0261	1	1	100
Arsenic	0.00380	0.00380	0.00380	1	0	0
Beryllium	0.00100	0.00100	0.00100	1	0	0
Cadmium	0.0358	0.0358	0.0358	1	1	100
Chromium	0.275	0.275	0.275	1	1	100
Copper	4.86	4.86	4.86	1	1	100
Lead	0.957	0.957	0.957	1	1	100
Mercury	0.000200	0.000200	0.000200	1	0	0
Nickel	0.0372	0.0372	0.0372	1	1	100

Table B-1 (Continued)

Steam-Tumbled Printer Towels						
	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
Constituent Name	**Minimum**	**Maximum**	**Mean**			
Selenium	0.0230	0.0230	0.0230	1	0	0
Silver	0.0653	0.0653	0.0653	1	1	100
Thallium	0.0120	0.0120	0.0120	1	0	0
Zinc	2.10	2.10	2.10	1	1	100
Nonconventional Metals and Elements						
Aluminum	2.80	2.80	2.80	1	1	100
Barium	1.63	1.63	1.63	1	1	100
Boron	0.0500	0.0500	0.0500	1	0	0
Cobalt	0.202	0.202	0.202	1	1	100
Iron	2.62	2.62	2.62	1	1	100
Manganese	0.277	0.277	0.277	1	1	100
Molybdenum	2.64	2.64	2.64	1	1	100
Tin	0.0761	0.0761	0.0761	1	1	100
Titanium	0.0178	0.0178	0.0178	1	1	100
Vanadium	0.0221	0.0221	0.0221	1	1	100
Yttrium	0.00500	0.00500	0.00500	1	0	0
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	9,000	9,000	9,000	1	1	100
Total Organic Carbon (TOC)	1,770	1,770	1,770	1	1	100
Total Petroleum Hydrocarbon (measured as SGT-HEM)	468	468	468	1	1	100

Table B-1 (Continued)

Items Dry Cleaned Prior to Water Washing						
Constituent Name	Concentration (mg/L)[1] Minimum	Maximum	Mean	Number of Times Analyzed for	Number of Times Detected	Percentage Detected
Conventionals						
Biochemical Oxygen Demand 5-Day (BOD_5)	110	120	113	3	3	100
Total Suspended Solids (TSS)	70	93	82	3	3	100
Priority Organics						
Ethylbenzene	0.00200	0.232	0.0458	11	8	73
Toluene	0.00200	1.23	0.225	11	8	73
Priority Metals and Elements						
Arsenic	0.00500	0.00500	0.00500	3	0	0
Cadmium	0.0100	0.150	0.0825	4	3	75
Chromium	0.0200	0.1700	0.0933	3	3	100
Copper	0.0600	0.940	0.668	4	4	100
Lead	0.00500	1.50	0.519	3	2	67
Mercury	0.000100	0.000200	0.000150	4	0	0
Nickel	0.0200	0.0200	0.0200	3	0	0
Silver	0.00500	0.00500	0.00500	5	0	0
Zinc	0.350	0.640	0.450	3	3	100
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	528	804	638	3	3	100

Table B-1 (Continued)

Linen Supply Items						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Conventionals						
Biochemical Oxygen Demand 5-Day (BOD_5)	50	2,520	881	9	9	100
Oil and Grease (measured as HEM)	72	142	108	3	3	100
Total Suspended Solids (TSS)	35	1,060	269	9	9	100
Priority Organics						
1,1,1-Trichloroethane	0.00500	0.0100	0.00833	5	0	0
1,2-Diphenylhydrazine	0.0200	0.0200	0.0200	3	0	0
4-Chloro-3-methylphenol	0.0100	0.0100	0.0100	3	0	0
Bis(2-ethylhexyl) Phthalate	0.0410	1.49	0.574	3	3	100
Butyl Benzyl Phthalate	0.0100	0.263	0.0944	3	1	33
Chlorobenzene	0.00500	0.0100	0.00833	5	0	0
Chloroform	0.0100	2.58	0.889	5	5	100
Di-*n*-butyl Phthalate	0.0100	0.0717	0.0306	3	1	33
Di-*n*-octyl Phthalate	0.0100	0.130	0.0572	3	2	67
Ethylbenzene	0.00500	0.0100	0.00833	5	0	0
Isophorone	0.0100	0.0100	0.0100	3	0	0
Methylene Chloride	0.0100	0.0130	0.0112	5	2	40
Naphthalene	0.0100	0.304	0.108	3	1	33
Phenol	0.0467	0.104	0.0674	3	3	100
Tetrachloroethene	0.00500	0.0100	0.00833	5	0	0
Toluene	0.00500	0.152	0.0241	5	1	20
trans-1,2-Dichloroethene	0.00500	0.0100	0.00833	5	0	0
Trichloroethene	0.00500	0.0100	0.00833	5	0	0
Nonconventional Organics						
2-Butanone	0.0500	0.0500	0.0500	3	0	0
2-Methylnaphthalene	0.01000	0.0291	0.0164	3	1	33
2-Propanone	0.0500	0.0804	0.0607	3	2	67
4-Methyl-2-pentanone	0.0500	0.0500	0.0500	3	0	0
∝-Terpineol	0.0100	0.0817	0.0339	3	1	33

Table B-1 (Continued)

Linen Supply Items						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Benzoic Acid	0.116	0.216	0.150	3	3	100
Benzyl Alcohol	0.0100	0.575	0.202	3	2	67
Hexanoic Acid	0.0100	0.0418	0.0279	3	2	67
m-Xylene	0.0100	0.0100	0.0100	3	0	0
n-Decane	0.0100	7.87	2.63	3	1	33
n-Docosane	0.0100	0.0732	0.0392	3	2	67
n-Dodecane	0.0100	0.513	0.270	3	2	67
n-Eicosane	0.0100	0.209	0.0862	3	2	67
n-Hexacosane	0.0100	0.0598	0.0267	3	2	67
n-Hexadecane	0.0100	0.458	0.160	3	2	67
n-Octacosane	0.0100	0.0436	0.0212	3	1	33
n-Octadecane	0.0100	0.169	0.0720	3	2	67
n-Tetracosane	0.0100	0.128	0.0630	3	2	67
n-Tetradecane	0.0100	0.400	0.140	3	1	33
n-Triacontane	0.0100	0.126	0.0551	3	2	67
o-&*p*-Xylene	0.0100	0.0100	0.0100	3	0	0
p-Cresol	0.0100	0.0100	0.0100	3	0	0
p-Cymene	0.0100	0.305	0.108	3	1	33
Pentamethylbenzene	0.0100	0.0100	0.0100	3	0	0
Priority Metals and Elements						
Antimony	0.00810	0.3130	0.114	3	2	67
Arsenic	0.00880	0.300	0.156	4	3	75
Beryllium	0.00100	0.00100	0.00100	3	0	0
Cadmium	0.00500	0.0500	0.0219	15	2	13
Chromium	0.0100	0.140	0.0492	15	7	47
Copper	0.0500	2.50	0.527	15	14	93
Lead	0.0400	0.500	0.151	15	8	53
Mercury	0.000200	0.00300	0.00165	4	2	50
Nickel	0.0150	0.280	0.0771	15	6	40

Table B-1 (Continued)

Linen Supply Items						
Constituent Name	Concentration (mg/L)[1]			Number of Times Analyzed for	Number of Times Detected	Percentage Detected
	Minimum	Maximum	Mean			
Selenium	0.00200	0.300	0.151	4	0	0
Silver	0.00500	0.0700	0.0291	14	6	43
Thallium	0.00100	0.0100	0.00700	3	0	0
Zinc	0.120	1.10	0.381	17	17	100
Nonconventional Metals and Elements						
Aluminum	1.35	4.70	3.08	3	3	100
Barium	0.0804	0.646	0.301	3	3	100
Boron	0.0310	0.229	0.0970	3	1	33
Cobalt	0.00900	0.0117	0.00990	3	1	33
Iron	1.09	8.93	3.26	5	5	100
Manganese	0.0285	0.147	0.0812	3	3	100
Molybdenum	0.0100	0.0588	0.0263	3	1	33
Tin	0.0290	0.0290	0.0290	3	0	0
Titanium	0.0267	0.105	0.0654	3	3	100
Vanadium	0.00800	0.0133	0.00990	3	2	67
Yttrium	0.00300	0.00810	0.00470	3	1	33
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	197	1,520	844	7	7	100
Total Organic Carbon (TOC)	310	494	401	3	3	100
Total Petroleum Hydrocarbon (measured as SGT-HEM)	9	19	12	3	3	100

[1]The detection limit concentration was used in calculations for data points reported as non-detects.

Table B-2

Wastewater Characterization Data for Wastewater Streams at Industrial Laundries

Wastewater Characterization Data for Heavy Wastewater						
Pollutant of Concern	Concentration (mg/L)[1]			Number of Times Analyzed	Number of Times Detected	Percentage Detected (%)
	Minimum	Maximum	Mean			
Conventionals						
Biochemical Oxygen Demand 5-Day (BOD_5)	1,600	9,810	4,160	18	18	100
Oil and Grease (measured as HEM)	612	6,410	2,950	18	18	100
Total Suspended Solids (TSS)	213	7,000	2,320	18	18	100
Priority Organics						
1,1,1-Trichloroethane	0.0100	10.3	1.16	18	5	28
1,2-Diphenylhydrazine	0.0200	41.3	2.60	18	3	17
4-Chloro-3-methylphenol	0.0100	1.00	0.260	18	2	11
Bis(2-ethylhexyl) Phthalate	0.0353	42.0	11.6	18	16	89
Butyl Benzyl Phthalate	0.0100	74.4	8.96	18	6	33
Chlorobenzene	0.00992	1.00	0.271	18	0	0
Chloroform	0.0100	1.00	0.296	18	5	28
Di-*n*-butyl Phthalate	0.0100	9.98	1.45	18	12	67
Di-*n*-octyl Phthalate	0.100	1.69	0.599	18	6	33
Ethylbenzene	0.100	18.7	3.65	18	17	94
Isophorone	0.0100	1.00	0.207	18	0	0
Methylene Chloride	0.0100	6.62	0.854	18	7	39
Naphthalene	0.388	18.8	5.07	18	18	100
Phenol	0.0100	1.00	0.303	18	3	17

Table B-2 (Continued)

Wastewater Characterization Data for Heavy Wastewater

Pollutant of Concern	Concentration (mg/L)[1] Minimum	Concentration (mg/L)[1] Maximum	Concentration (mg/L)[1] Mean	Number of Times Analyzed	Number of Times Detected	Percentage Detected (%)
Tetrachloroethene	0.0100	7.88	1.79	18	11	61
Toluene	0.321	41.8	9.69	18	18	100
trans-1,2-Dichloroethene	0.00992	1.00	0.271	18	0	0
Trichloroethene	0.00992	20.0	1.27	18	1	6
Nonconventional Organics						
2-Butanone	0.0500	272	25.5	18	11	61
2-Methylnaphthalene	0.100	2.24	0.892	18	12	67
2-Propanone	0.552	52.7	8.49	18	16	89
4-Methyl-2-pentanone	0.0500	69.9	5.82	18	11	61
∝-Terpineol	0.100	2.26	0.379	18	6	33
Benzoic Acid	0.0500	12.2	3.36	18	9	50
Benzyl Alcohol	0.0100	10.7	1.56	18	4	22
Hexanoic Acid	0.0100	1.00	0.210	18	1	6
m-Xylene	0.0751	25.0	4.47	13	13	100
n-Decane	0.100	419	86.5	18	17	94
n-Docosane	0.100	2.50	0.504	18	7	39
n-Dodecane	0.0459	106	29.5	18	17	94
n-Eicosane	0.100	26.5	4.41	18	17	94
n-Hexacosane	0.100	1.28	0.354	18	5	28
n-Hexadecane	0.269	38.4	9.49	18	18	100
n-Octacosane	0.100	1.44	0.370	18	4	22
n-Octadecane	0.100	13.6	4.00	18	17	94

Table B-2 (Continued)

Wastewater Characterization Data for Heavy Wastewater						
	Concentration (mg/L)[1]			Number of Times Analyzed	Number of Times Detected	Percentage Detected (%)
Pollutant of Concern	**Minimum**	**Maximum**	**Mean**			
n-Tetracosane	0.0100	1.05	0.316	18	4	22
n-Tetradecane	0.100	41.6	7.23	18	15	83
n-Triacontane	0.0100	1.00	0.366	18	4	22
o-&*p*-Xylene	0.0438	17.8	3.59	13	13	100
p-Cresol	0.0100	1.00	0.204	18	0	0
p-Cymene	0.0100	12.2	3.55	18	11	61
Pentamethylbenzene	0.0100	1.97	0.412	18	6	33
Priority Metals and Elements						
Antimony	0.0200	8.24	0.788	18	14	78
Arsenic	0.00100	0.0396	0.0125	18	9	50
Beryllium	0.000970	0.00341	0.00142	18	7	39
Cadmium	0.0236	0.331	0.121	18	18	100
Chromium	0.0990	0.726	0.296	18	18	100
Copper	2.08	11.6	5.37	18	18	100
Lead	0.3500	3.78	1.60	18	18	100
Mercury	0.000200	0.00665	0.000816	18	9	50
Nickel	0.0541	0.861	0.266	18	18	100
Selenium	0.000500	0.0451	0.0174	18	7	39
Silver	0.00230	1.25	0.199	18	13	72
Thallium	0.000900	0.0526	0.00989	18	4	22

Table B-2 (Continued)

Wastewater Characterization Data for Heavy Wastewater						
Pollutant of Concern	Concentration (mg/L)[1]			Number of Times Analyzed	Number of Times Detected	Percentage Detected (%)
	Minimum	Maximum	Mean			
Zinc	2.54	15.7	7.79	18	18	100
Nonconventional Metals and Elements						
Aluminum	4.10	21.0	9.97	18	18	100
Barium	1.25	7.22	3.63	18	18	100
Boron	0.0310	37.2	4.93	18	17	94
Cobalt	0.0620	3.10	0.449	18	18	100
Iron	6.89	96.6	42.1	18	18	100
Manganese	0.381	6.31	1.51	18	18	100
Molybdenum	0.145	2.29	0.668	18	18	100
Tin	0.0290	0.589	0.130	18	15	83
Titanium	0.0843	1.32	0.344	18	18	100
Vanadium	0.00800	0.0892	0.0381	18	16	89
Yttrium	0.000300	0.0417	0.0101	18	11	61
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	1,620	29,300	13,700	18	18	100
Total Organic Carbon (TOC)	106	6,240	2,790	18	18	100
Total Petroleum Hydrocarbon (measured as SGT-HEM)	101	4,120	1,440	18	18	100

Table B-2 (Continued)

Wastewater Characterization Data for Light Wastewater						
	Concentration (mg/L)[1]					
Pollutant of Concern	Minimum	Maximum	Mean	Number of Times Analyzed	Number of Times Detected	Percentage Detected (%)
Conventionals						
Biochemical Oxygen Demand 5-Day (BOD_5)	120	1,280	568	14	14	100
Oil and Grease (measured as HEM)	14	430	154	14	14	100
Total Suspended Solids (TSS)	124	804	344	14	14	100
Priority Organics						
1,1,1-Trichloroethane	0.0100	0.100	0.0160	14	0	0
1,2-Diphenylhydrazine	0.0200	1.62	0.220	14	2	14
4-Chloro-3-methylphenol	0.0100	0.100	0.0411	14	2	14
Bis(2-ethylhexyl) Phthalate	0.116	6.02	1.10	14	14	100
Butyl Benzyl Phthalate	0.0100	0.353	0.0690	14	7	50
Chlorobenzene	0.0100	0.100	0.0160	14	0	0
Chloroform	0.0100	0.100	0.0455	14	12	86
Di-*n*-butyl Phthalate	0.0100	1.04	0.104	14	4	29
Di-*n*-octyl Phthalate	0.0100	0.177	0.0667	14	7	50
Ethylbenzene	0.0100	0.282	0.0620	14	12	86
Isophorone	0.0100	0.100	0.0400	14	0	0
Methylene Chloride	0.0100	0.100	0.0213	14	2	14
Naphthalene	0.0195	1.04	0.358	14	11	79
Phenol	0.0100	0.580	0.105	14	7	50
Tetrachloroethene	0.0100	0.797	0.0977	14	9	64
Toluene	0.0225	0.110	0.0553	14	13	93

Table B-2 (Continued)

Wastewater Characterization Data for Light Wastewater						
	Concentration (mg/L)[1]					
Pollutant of Concern	Minimum	Maximum	Mean	Number of Times Analyzed	Number of Times Detected	Percentage Detected (%)
trans-1,2-Dichloroethene	0.0100	0.100	0.0160	14	0	0
Trichloroethene	0.0100	0.100	0.0160	14	0	0
Nonconventional Organics						
2-Butanone	0.0500	0.862	0.147	14	4	29
2-Methylnaphthalene	0.0100	0.198	0.0566	14	8	57
2-Propanone	0.0759	2.52	0.518	14	13	93
4-Methyl-2-pentanone	0.0500	2.29	0.240	14	3	21
∝-Terpineol	0.0100	0.449	0.123	14	9	64
Benzoic Acid	0.0500	0.772	0.306	14	5	36
Benzyl Alcohol	0.0100	0.283	0.102	14	8	57
Hexanoic Acid	0.0100	0.103	0.0557	14	4	29
m-Xylene	0.0173	0.143	0.0555	9	9	100
n-Decane	0.0447	1.62	0.354	14	13	93
n-Docosane	0.0100	0.293	0.0591	14	8	57
n-Dodecane	0.0100	10.8	0.973	14	9	64
n-Eicosane	0.0123	0.756	0.124	14	10	71
n-Hexacosane	0.0100	0.102	0.0465	14	5	36
n-Hexadecane	0.0107	1.13	0.330	14	11	79
n-Octacosane	0.0100	0.100	0.0432	14	6	43
n-Octadecane	0.0100	0.253	0.0850	14	11	79
n-Tetracosane	0.0100	0.456	0.0680	14	5	36

Table B-2 (Continued)

Wastewater Characterization Data for Light Wastewater						
	Concentration (mg/L)[1]					
Pollutant of Concern	Minimum	Maximum	Mean	Number of Times Analyzed	Number of Times Detected	Percentage Detected (%)
n-Tetradecane	0.0100	0.771	0.103	14	8	57
n-Triacontane	0.0100	0.109	0.0492	14	6	43
o-&*p*-Xylene	0.0108	0.241	0.0765	9	9	100
p-Cresol	0.0100	0.100	0.0400	14	0	0
p-Cymene	0.0100	0.100	0.0473	14	2	14
Pentamethylbenzene	0.0100	0.264	0.0787	14	4	29
Priority Metals and Elements						
Antimony	0.0201	13.8	1.32	14	10	71
Arsenic	0.00100	0.0200	0.00653	14	4	29
Beryllium	0.000470	0.00148	0.000938	14	5	36
Cadmium	0.00120	0.0434	0.0211	14	9	64
Chromium	0.0165	0.317	0.113	14	14	100
Copper	0.200	1.95	0.858	14	14	100
Lead	0.0460	0.810	0.348	14	13	93
Mercury	0.000200	0.00141	0.000715	14	9	64
Nickel	0.0180	0.339	0.101	14	11	79
Selenium	0.000500	0.0308	0.0133	14	2	14
Silver	0.00230	0.00820	0.00432	14	4	29
Thallium	0.000900	0.0100	0.00313	14	0	0
Zinc	0.624	2.79	1.47	14	14	100

Table B-2 (Continued)

Wastewater Characterization Data for Light Wastewater						
Pollutant of Concern	Concentration (mg/L)[1]			Number of Times Analyzed	Number of Times Detected	Percentage Detected (%)
	Minimum	Maximum	Mean			
Nonconventional Metals and Elements						
Aluminum	1.87	7.43	4.65	14	14	100
Barium	0.108	0.752	0.421	14	14	100
Boron	0.0360	3.07	0.391	14	11	79
Cobalt	0.00230	0.137	0.0264	14	6	43
Iron	2.26	27.5	10.3	14	14	100
Manganese	0.0628	0.353	0.184	14	14	100
Molybdenum	0.0100	0.0868	0.0357	14	11	79
Tin	0.0290	0.211	0.0625	14	10	71
Titanium	0.0404	0.724	0.206	14	14	100
Vanadium	0.00200	0.0393	0.0138	14	4	29
Yttrium	0.00030	0.0114	0.00313	14	1	7
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	500	2,360	1,410	14	14	100
Total Organic Carbon (TOC)	117	540	338	14	14	100
Total Petroleum Hydrocarbon (measured as SGT-HEM)	5	282	85	14	12	86

Table B-2 (Continued)

Wastewater Characterization Data for Total Stream Wastewater						
Pollutant of Concern	Concentration (mg/L)[1]			Number of Times Analyzed	Number of Times Detected	Percentage Detected (%)
	Minimum	Maximum	Mean			
Conventionals						
Biochemical Oxygen Demand 5-Day (BOD_5)	82	3,470	879	51	51	100
Oil and Grease (measured as HEM)	558	2,130	1,450	8	8	100
Total Suspended Solids (TSS)	60	4,070	849	51	51	100
Priority Organics						
1,1,1-Trichloroethane	0.00100	5.56	0.334	18	12	67
1,2-Diphenylhydrazine	0.000025	0.200	0.0984	16	0	0
4-Chloro-3-methylphenol	0.000005	0.315	0.070	17	2	12
Bis(2-ethylhexyl) Phthalate	0.000420	38.9	5.42	17	17	100
Butyl Benzyl Phthalate	0.000005	1.23	0.139	17	5	29
Chlorobenzene	0.000100	1.41	0.155	18	7	39
Chloroform	0.00200	0.100	0.0344	18	12	67
Di-*n*-butyl Phthalate	0.000005	3.49	0.273	17	4	24
Di-*n*-octyl Phthalate	0.000005	0.493	0.103	17	5	29
Ethylbenzene	0.00200	3.95	0.681	38	32	84
Isophorone	0.000005	0.529	0.0790	17	3	18
Methylene Chloride	0.005000	4.13	0.390	27	16	59
Naphthalene	0.000014	13.6	1.72	17	14	82
Phenol	0.000005	0.464	0.0861	20	9	45
Tetrachloroethene	0.00100	46.2	3.69	18	15	83
Toluene	0.000500	20.9	2.49	47	41	87

Table B-2 (Continued)

Wastewater Characterization Data for Total Stream Wastewater						
	Concentration (mg/L)[1]					
Pollutant of Concern	Minimum	Maximum	Mean	Number of Times Analyzed	Number of Times Detected	Percentage Detected (%)
trans-1,2-Dichloroethene	0.00500	0.100	0.0230	14	0	0
Trichloroethene	0.000020	0.100	0.0211	18	4	22
Nonconventional Organics						
2-Butanone	0.00500	47.5	2.98	20	14	70
2-Methylnaphthalene	0.0150	0.405	0.157	13	9	69
2-Propanone	0.00500	61.8	12.8	20	18	90
4-Methyl-2-pentanone	0.00500	16.7	1.89	14	9	64
∝-Terpineol	0.0100	2.27	0.326	12	4	33
Benzoic Acid	0.0200	3.13	0.779	13	8	62
Benzyl Alcohol	0.0100	0.269	0.0753	13	3	23
Hexanoic Acid	0.0100	0.175	0.0854	12	2	17
m-Xylene	0.0393	25.3	5.56	13	13	100
n-Decane	1.31	712	97.0	12	12	100
n-Docosane	0.0200	3.04	0.680	12	9	75
n-Dodecane	1.13	17.5	6.75	12	12	100
n-Eicosane	0.0200	6.41	2.12	12	11	92
n-Hexacosane	0.0200	3.28	0.529	12	10	83
n-Hexadecane	0.0200	22.5	5.57	12	11	92
n-Octacosane	0.0108	0.251	0.103	12	6	50
n-Octadecane	0.0382	8.97	1.82	12	12	100

Table B-2 (Continued)

Wastewater Characterization Data for Total Stream Wastewater						
	Concentration (mg/L)[1]			Number of Times Analyzed	Number of Times Detected	Percentage Detected (%)
Pollutant of Concern	Minimum	Maximum	Mean			
n-Tetracosane	0.0200	8.34	1.63	12	10	83
n-Tetradecane	0.236	19.9	5.08	12	12	100
n-Triacontane	0.0296	0.531	0.160	12	9	75
o-&*p*-Xylene	0.125	9.45	3.02	13	13	100
p-Cresol	0.0100	0.100	0.0713	12	0	0
p-Cymene	0.0100	0.360	0.143	12	6	50
Pentamethylbenzene	0.0100	2.33	0.313	12	1	8
Priority Metals and Elements						
Antimony	0.0589	0.144	0.0945	12	8	67
Arsenic	0.00100	0.180	0.0185	31	17	55
Beryllium	0.00100	0.0200	0.00752	12	4	33
Cadmium	0.00300	0.290	0.0574	42	39	93
Chromium	0.00360	3.59	0.263	45	35	78
Copper	0.0357	6.19	1.36	44	44	100
Lead	0.00500	3.26	0.809	45	44	98
Mercury	0.000100	0.00800	0.00110	31	20	65
Nickel	0.0100	2.87	0.165	41	35	85
Selenium	0.00100	0.258	0.0648	25	13	52
Silver	0.000500	0.500	0.0278	48	31	65
Thallium	0.00100	0.130	0.0248	12	2	17
Zinc	0.139	6.89	2.16	45	45	100

Table B-2 (Continued)

Wastewater Characterization Data for Total Stream Wastewater						
Pollutant of Concern	Concentration (mg/L)[1]			Number of Times Analyzed	Number of Times Detected	Percentage Detected (%)
	Minimum	Maximum	Mean			
Nonconventional Metals and Elements						
Aluminum	0.441	14.0	5.86	19	19	100
Barium	0.240	2.93	1.18	18	18	100
Boron	0.0500	1.89	0.701	12	10	83
Cobalt	0.141	0.289	0.184	12	8	67
Iron	13.6	58.3	30.9	12	12	100
Manganese	0.190	1.40	0.504	15	15	100
Molybdenum	0.110	0.793	0.386	12	12	100
Tin	0.0290	0.580	0.176	12	7	58
Titanium	0.0190	0.370	0.166	12	12	100
Vanadium	0.00820	0.190	0.0710	12	9	75
Yttrium	0.00200	0.0300	0.0127	12	3	25
Bulk Nonconventionals						
Chemical Oxygen Demand (COD)	528	10,600	5,290	22	22	100
Total Organic Carbon (TOC)	619	2,700	1,440	12	12	100
Total Petroleum Hydrocarbon (measured as SGT-HEM)	139	1,170	530	8	8	100

[1]The detection limit concentration was used in calculations for data points reported as non-detects.

Appendix C

Tables Referenced In Chapter 6

Table C-1
Industries for Which EPA Has Established Effluent Limitations Guidelines and Standards

CWA Part	Industry
405	Diary Products Processing
406	Grain Mills
407	Canned and Preserved Fruits and Vegetables Processing
408	Canned and Preserved Seafood Processing
409	Sugar Processing
410	Textile Mills
411	Cement Manufacturing
412	Feedlots
413	Electroplating
414	Organic Chemicals, Plastics and Synthetic Fibers
415	Inorganic Chemical Manufacturing
417	Soap and Detergent Manufacturing
418	Fertilizer Manufacturing
419	Petroleum Refining
420	Iron and Steel Manufacturing
421	Nonferrous Metals Manufacturing
422	Phosphate Manufacturing
423	Steam Electric Power Generating
424	Ferroalloy Manufacturing
425	Leather Tanning and Finishing
426	Glass Manufacturing
427	Asbestos Manufacturing
428	Rubber Manufacturing
429	Timber Products Processing
430	Pulp, Paper and Paperboard
431	The Builders' Paper and Boardmills
432	Meat Products

Table C-1 (Continued)

CWA Part	Industry
433	Metal Finishing
434	Coal Mining
435	Oil and Gas Extraction
436	Mineral and Mining Processing
439	Pharmaceutical Manufacturing
440	Ore Mining and Dressing
443	Paving and Roofing Materials (Tars and Asphalt)
446	Paint Formulating
447	Ink Formulating
454	Gum and Wood Chemicals Manufacturing
455	Pesticide Chemicals
457	Explosives Manufacturing
458	Carbon Black Manufacturing
459	Photographic Processing
460	Hospital
461	Battery Manufacturing
463	Plastics Molding and Forming
464	Metal Molding and Casting
465	Coil Coating
466	Porcelain Enameling
467	Aluminum Forming
468	Copper Forming
469	Electrical and Electronic Components
471	Nonferrous Metals Forming and Metal Powder

Appendix D

Tables Referenced in Chapter 7

Table D-1
Priority Pollutant List[1]

1 Acenaphthene	66 Bis(2-Ethylhexyl) Phthalate
2 Acrolein (2-Propenal)	67 Butyl Benzyl Phthalate
3 Acrylonitrile	68 Di-n-butyl Phthalate
4 Benzene	69 Di-n-octyl Phthalate
5 Benzidine	70 Diethyl Phthalate
6 Carbon Tetrachloride (Tetrachloromethane)	71 Dimethyl Phthalate
7 Chlorobenzene	72 Benzo(a)anthracene (1,2-Benzanthracene)
8 1,2,4-Trichlorobenzene	73 Benzo(a)pyrene (3,4-Benzopyrene)
9 Hexachlorobenzene	74 Benzo(b)fluoranthene (3,4-Benzo fluoranthene)
10 1,2-Dichloroethane	75 Benzo(k)fluoranthene
11 1,1,1-Trichloroethane	76 Chrysene
12 Hexachloroethane	77 Acenaphthylene
13 1,1-Dichloroethane	78 Anthracene
14 1,1,2-Trichloroethane	79 Benzo(ghi)perylene (1,12-Benzoperylene)
15 1,1,2,2-Tetrachloroethane	80 Fluorene
16 Chloroethane	81 Phenanthrene
17 Removed	82 Dibenzo(a,h)anthracene (1,2,5,6-Dibenzanthracene)
18 Bis(2-chloroethyl) Ether	83 Indeno(1,2,3-cd)pyrene (2,3-o-Phenylenepyrene)
19 2-Chloroethyl Vinyl Ether (mixed)	84 Pyrene
20 2-Chloronaphthalene	85 Tetrachloroethylene (Tetrachloroethene)
21 2,4,6-Trichlorophenol	86 Toluene
22 Parachloro-m-cresol (4-Chloro-3-Methylphenol)	87 Trichloroethylene (Trichloroethene)
23 Chloroform (Trichloromethane)	88 Vinyl Chloride (Chloroethylene)
24 2-Chlorophenol	89 Aldrin
25 1,2-Dichlorobenzene	90 Dieldrin
26 1,3-Dichlorobenzene	91 Chlordane (Technical Mixture & Metabolites)
27 1,4-Dichlorobenzene	92 4,4'-DDT (p,p'-DDT)
28 3,3'-Dichlorobenzidine	93 4,4'-DDE (p,p'-DDX)
29 1,1-Dichloroethene	94 4,4'-DDD (p,p'-TDE)
30 1,2-Trans-Dichloroethene	95 Alpha-endosulfan
31 2,4-Dichlorophenol	96 Beta-endosulfan
32 1,2-Dichloropropane	97 Endosulfan Sulfate
33 1,3-Dichloropropylene (1,3-Dichloropropene)	98 Endrin
34 2,4-Dimethylphenol	99 Endrin Aldehyde
35 2,4-Dinitrotoluene	100 Heptachlor
36 2,6-Dinitrotoluene	101 Heptachlor Epoxide
37 1,2-Diphenylhydrazine	102 Alpha-BHC
38 Ethylbenzene	103 Beta-BHC
39 Fluoranthene	104 Gamma-BHC (Lindane)
40 4-Chlorophenyl Phenyl Ether	105 Delta-BHC
41 4-Bromophenyl Phenyl Ether	106 PCB-1242 (Arochlor 1242)
42 Bis(2-Chloroisopropyl) Ether	107 PCB-1254 (Arochlor 1254)
43 Bis(2-Chloroethoxy) Methane	108 PCB-1221 (Arochlor 1221)
44 Methylene Chloride (Dichloromethane)	109 PCB-1232 (Arochlor 1232)
45 Methyl Chloride (Chloromethane)	110 PCB-1248 (Arochlor 1248)
46 Methyl Bromide (Bromomethane)	111 PCB-1260 (Arochlor 1260)
47 Bromoform (Tribromomethane)	112 PCB-1016 (Arochlor 1016)
48 Dichlorobromomethane (Bromodichloromethane)	113 Toxaphene
49 Removed	114 Antimony (total)
50 Removed	115 Arsenic (total)
51 Chlorodibromomethane (Dibromochloromethane)	116 Asbestos (fibrous)
52 Hexachlorobutadiene	117 Beryllium (total)
53 Hexachlorocyclopentadiene	118 Cadmium (total)
54 Isophorone	119 Chromium (total)
55 Naphthalene	120 Copper (total)
56 Nitrobenzene	121 Cyanide (total)
57 2-Nitrophenol	122 Lead (total)
58 4-Nitrophenol	123 Mercury (total)
59 2,4-Dinitrophenol	124 Nickel (total)
60 4,6-Dinitro-o-Cresol (Phenol, 2-methyl-4,6-dinitro)	125 Selenium (total)
61 N-Nitrosodimethylamine	126 Silver (total)
62 N-Nitrosodiphenylamine	127 Thallium (total)
63 N-Nitrosodi-n-propylamine (Di-n-propylnitrosamine)	128 Zinc (total)
64 Pentachlorophenol	129 2,3,7,8-Tetrachlorodibenzo-p-Dioxin
65 Phenol	

Source: 40 CFR Part 423, Appendix A

[1]Priority pollutants are numbered 1 through 129 but include 126 pollutants since EPA removed three pollutants from the list (Numbers 17, 49, and 50).

Table D-2
Pollutants Considered for Regulation

POLLUTANT	ANALYTICAL METHOD
1,1,1,2-TETRACHLOROETHANE	1624
1,1,1-TRICHLOROETHANE	1624
1,1,2,2-TETRACHLOROETHANE	1624
1,1,2-TRICHLOROETHANE	1624
1,1-DICHLOROETHANE	1624
1,1-DICHLOROETHENE	1624
1,2,3-TRICHLOROBENZENE	1625
1,2,3-TRICHLOROPROPANE	1624
1,2,3-TRIMETHOXYBENZENE	1625
1,2,4,5-TETRACHLOROBENZENE	1625
1,2,4-TRICHLOROBENZENE	1625
1,2-DIBROMO-3-CHLOROPROPANE	1625
1,2-DIBROMOETHANE	1624
1,2-DICHLOROBENZENE	1625
1,2-DICHLOROETHANE	1624
1,2-DICHLOROPROPANE	1624
1,2-DIPHENYLHYDRAZINE	1625
1,2:3,4-DIEPOXYBUTANE	1625
1,3,5-TRITHIANE	1625
1,3-BUTADIENE, 2-CHLORO	1624
1,3-DICHLORO-2-PROPANOL	1625
1,3-DICHLOROBENZENE	1625
1,3-DICHLOROPROPANE	1624
1,4-DICHLOROBENZENE	1625
1,4-DINITROBENZENE	1625
1,4-DIOXANE	1624
1,4-NAPHTHOQUINONE	1625
1,5-NAPHTHALENEDIAMINE	1625
1-BROMO-2-CHLOROBENZENE	1625
1-BROMO-3-CHLOROBENZENE	1625
1-CHLORO-3-NITROBENZENE	1625
1-METHYLFLUORENE	1625
1-METHYLPHENANTHRENE	1625
1-NAPHTHYLAMINE	1625
1-PHENYLNAPHTHALENE	1625

Table D-2 (Continued)

POLLUTANT	ANALYTICAL METHOD
2,3,4,6-TETRACHLOROPHENOL	1625
2,3,6-TRICHLOROPHENOL	1625
2,3-BENZOFLUORENE	1625
2,3-DICHLOROANILINE	1625
2,3-DICHLORONITROBENZENE	1625
2,4,5-TRICHLOROPHENOL	1625
2,4,6-TRICHLOROPHENOL	1625
2,4-DICHLOROPHENOL	1625
2,4-DIMETHYLPHENOL	1625
2,4-DINITROPHENOL	1625
2,4-DINITROTOLUENE	1625
2,6-DI-TERT-BUTYL-P-BENZOQUINONE	1625
2,6-DICHLORO-4-NITROANILINE	1625
2,6-DICHLOROPHENOL	1625
2,6-DINITROTOLUENE	1625
2-(METHYLTHIO)BENZOTHIAZOLE	1625
2-BUTANONE	1624
2-CHLOROETHYLVINYL ETHER	1624
2-CHLORONAPHTHALENE	1625
2-CHLOROPHENOL	1625
2-HEXANONE	1624
2-ISOPROPYLNAPHTHALENE	1625
2-METHYLBENZOTHIOAZOLE	1625
2-METHYLNAPHTHALENE	1625
2-NITROANILINE	1625
2-NITROPHENOL	1625
2-PHENYLNAPHTHALENE	1625
2-PICOLINE	1625
2-PROPANONE	1624
2-PROPEN-1-OL	1624
2-PROPENAL	1624
2-PROPENENITRILE, 2-METHYL-	1624
3,3'-DICHLOROBENZIDINE	1625
3,3'-DIMETHOXYBENZIDINE	1625
3,6-DIMETHYLPHENANTHRENE	1625
3-CHLOROPROPENE	1624

Table D-2 (Continued)

POLLUTANT	ANALYTICAL METHOD
3-METHYLCHOLANTHRENE	1625
3-NITROANILINE	1625
4,4'-METHYLENEBIS(2-CHLOROANILINE)	1625
4,5-METHYLENE PHENANTHRENE	1625
4-AMINOBIPHENYL	1625
4-BROMOPHENYL PHENYL ETHER	1625
4-CHLORO-2-NITROANILINE	1625
4-CHLORO-3-METHYLPHENOL	1625
4-CHLOROPHENYL PHENYL ETHER	1625
4-METHYL-2-PENTANONE	1624
4-NITROPHENOL	1625
5-NITRO-O-TOLUIDINE	1625
7,12-DIMETHYLBENZ(A)ANTHRACENE	1625
ACENAPHTHENE	1625
ACENAPHTHYLENE	1625
ACETOPHENONE	1625
ACRYLONITRILE	1624
ALPHA-TERPINEOL	1625
ALUMINUM	1620
ANILINE	1625
ANILINE, 2,4,5-TRIMETHYL-	1625
ANTHRACENE	1625
ANTIMONY	1620
ARAMITE	1625
ARSENIC	1620
BARIUM	1620
BENZANTHRONE	1625
BENZENE	1624
BENZENETHIOL	1625
BENZIDINE	1625
BENZO(A)ANTHRACENE	1625
BENZO(A)PYRENE	1625
BENZO(B)FLUORANTHENE	1625
BENZO(GHI)PERYLENE	1625
BENZO(K)FLUORANTHENE	1625
BENZOIC ACID	1625

Table D-2 (Continued)

POLLUTANT	ANALYTICAL METHOD
BENZONITRILE, 3,5-DIBROMO-4-HYDROXY-	1625
BENZYL ALCOHOL	1625
BERYLLIUM	1620
BETA-NAPHTHYLAMINE	1625
BIPHENYL	1625
BIPHENYL, 4-NITRO	1625
BIS(2-CHLOROETHOXY)METHANE	1625
BIS(2-CHLOROETHYL) ETHER	1625
BIS(2-CHLOROISOPROPYL) ETHER	1625
BIS(2-ETHYLHEXYL) PHTHALATE	1625
BISMUTH	1620
BOD 5-DAY (CARBONACEOUS)	405.1
BORON	1620
BROMODICHLOROMETHANE	1624
BROMOMETHANE	1624
BUTYL BENZYL PHTHALATE	1625
CADMIUM	1620
CALCIUM	1620
CARBAZOLE	1625
CARBON DISULFIDE	1624
CERIUM	1620
CHEMICAL OXYGEN DEMAND (COD)	410.4
CHLOROACETONITRILE	1624
CHLOROBENZENE	1624
CHLOROETHANE	1624
CHLOROFORM	1624
CHLOROMETHANE	1624
CHROMIUM	1620
CHRYSENE	1625
CIS-1,3-DICHLOROPROPENE	1624
COBALT	1620
COPPER	1620
CROTONALDEHYDE	1624
CROTOXYPHOS	1625
DI-N-BUTYL PHTHALATE	1625
DI-N-OCTYL PHTHALATE	1625

Table D-2 (Continued)

POLLUTANT	ANALYTICAL METHOD
DI-N-PROPYLNITROSAMINE	1625
DIBENZO(A,H)ANTHRACENE	1625
DIBENZOFURAN	1625
DIBENZOTHIOPHENE	1625
DIBROMOCHLOROMETHANE	1624
DIBROMOMETHANE	1624
DIETHYL ETHER	1624
DIETHYL PHTHALATE	1625
DIMETHYL PHTHALATE	1625
DIMETHYL SULFONE	1625
DIPHENYL ETHER	1625
DIPHENYLAMINE	1625
DIPHENYLDISULFIDE	1625
DYSPROSIUM	1620
ERBIUM	1620
ETHANE, PENTACHLORO-	1625
ETHYL CYANIDE	1624
ETHYL METHACRYLATE	1624
ETHYL METHANESULFONATE	1625
ETHYLBENZENE	1624
ETHYLENETHIOUREA	1625
EUROPIUM	1620
FLUORANTHENE	1625
FLUORENE	1625
GADOLINIUM	1620
GALLIUM	1620
GERMANIUM	1620
GOLD	1620
HAFNIUM	1620
HEXACHLOROBENZENE	1625
HEXACHLOROBUTADIENE	1625
HEXACHLOROCYCLOPENTADIENE	1625
HEXACHLOROETHANE	1625
HEXACHLOROPROPENE	1625
HEXANOIC ACID	1625
HOLMIUM	1620

Table D-2 (Continued)

POLLUTANT	ANALYTICAL METHOD
INDENO(1,2,3-CD)PYRENE	1625
INDIUM	1620
IODINE	1620
IODOMETHANE	1624
IRIDIUM	1620
IRON	1620
ISOBUTYL ALCOHOL	1624
ISOPHORONE	1625
ISOSAFROLE	1625
LANTHANUM	1620
LEAD	1620
LITHIUM	1620
LONGIFOLENE	1625
LUTETIUM	1620
M-XYLENE	1624
MAGNESIUM	1620
MALACHITE GREEN	1625
MANGANESE	1620
MERCURY	1620
MESTRANOL	1625
METHAPYRILENE	1625
METHYL METHACRYLATE	1624
METHYL METHANESULFONATE	1625
METHYLENE CHLORIDE	1624
MOLYBDENUM	1620
N,N-DIMETHYLFORMAMIDE	1625
N-DECANE	1625
N-DOCOSANE	1625
N-DODECANE	1625
N-EICOSANE	1625
N-HEXACOSANE	1625
N-HEXADECANE	1625
N-NITROSODI-N-BUTYLAMINE	1625
N-NITROSODIETHYLAMINE	1625
N-NITROSODIMETHYLAMINE	1625
N-NITROSODIPHENYLAMINE	1625

Table D-2 (Continued)

POLLUTANT	ANALYTICAL METHOD
N-NITROSOMETHYLETHYLAMINE	1625
N-NITROSOMETHYLPHENYLAMINE	1625
N-NITROSOMORPHOLINE	1625
N-NITROSOPIPERIDINE	1625
N-OCTACOSANE	1625
N-OCTADECANE	1625
N-TETRACOSANE	1625
N-TETRADECANE	1625
N-TRIACONTANE	1625
NAPHTHALENE	1625
NEODYMIUM	1620
NICKEL	1620
NIOBIUM	1620
NITROBENZENE	1625
O+P XYLENE	1624
O-ANISIDINE	1625
O-CRESOL	1625
O-TOLUIDINE	1625
O-TOLUIDINE, 5-CHLORO-	1625
OIL AND GREASE (measured as HEM)	1664
OSMIUM	1620
P-CHLOROANILINE	1625
P-CRESOL	1625
P-CYMENE	1625
P-DIMETHYLAMINOAZOBENZENE	1625
P-NITROANILINE	1625
PALLADIUM	1620
PENTACHLOROBENZENE	1625
PENTACHLOROPHENOL	1625
PENTAMETHYLBENZENE	1625
PERYLENE	1625
PH	150.1
PHENACETIN	1625
PHENANTHRENE	1625
PHENOL	1625
PHENOL, 2-METHYL-4,6-DINITRO-	1625

Table D-2 (Continued)

POLLUTANT	ANALYTICAL METHOD
PHENOTHIAZINE	1625
PHOSPHORUS	1620
PLATINUM	1620
POTASSIUM	1620
PRASEODYMIUM	1620
PRONAMIDE	1625
PYRENE	1625
PYRIDINE	1625
RESORCINOL	1625
RHENIUM	1620
RHODIUM	1620
RUTHENIUM	1620
SAFROLE	1625
SAMARIUM	1620
SCANDIUM	1620
SELENIUM	1620
SILICON	1620
SILVER	1620
SODIUM	1620
SQUALENE	1625
STRONTIUM	1620
STYRENE	1625
SULFUR	1620
SURFACTANTS (CTAS)	5540D
SURFACTANTS (MBAS)	5540C
TANTALUM	1620
TELLURIUM	1620
TERBIUM	1620
TETRACHLOROETHENE	1624
TETRACHLOROMETHANE	1624
THALLIUM	1620
THIANAPHTHENE	1625
THIOACETAMIDE	1625
THIOXANTHE-9-ONE	1625
THORIUM	1620
THULIUM	1620

Table D-2 (Continued)

POLLUTANT	ANALYTICAL METHOD
TIN	1620
TITANIUM	1620
TOLUENE	1624
TOLUENE, 2,4-DIAMINO-	1625
TOTAL HYDROLYZABLE PHOSPHORUS	365.2
TOTAL ORGANIC CARBON (TOC)	415.1
TOTAL ORTHOPHOSPHATE	365.2
TOTAL PETROLEUM HYDROCARBON (measured as SGT-HEM)	1664
TOTAL PHOSPHORUS	365.2
TOTAL SOLIDS	160.3
TOTAL SUSPENDED SOLIDS	160.2
TRANS-1,2-DICHLOROETHENE	1624
TRANS-1,3-DICHLOROPROPENE	1624
TRANS-1,4-DICHLORO-2-BUTENE	1624
TRIBROMOMETHANE	1624
TRICHLOROETHENE	1624
TRICHLOROFLUOROMETHANE	1624
TRIPHENYLENE	1625
TRIPROPYLENEGLYCOL METHYL ETHER	1625
TUNGSTEN	1620
URANIUM	1620
VANADIUM	1620
VINYL ACETATE	1624
VINYL CHLORIDE	1624
YTTERBIUM	1620
YTTRIUM	1620
ZINC	1620
ZIRCONIUM	1620